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TECHNICAL MANUAL

Including

OPERATION and SERVICE INSTRUCTIONS

AM-3568/45M

for

HICKOK

MODEL 1804-8

WIDE BAND - HIGH GAIN

PREAMPLIFIER

~~HP-162E~~?

THE HICKOK ELECTRICAL INSTRUMENT COMPANY
10514 Dupont Avenue
Cleveland 8, Ohio

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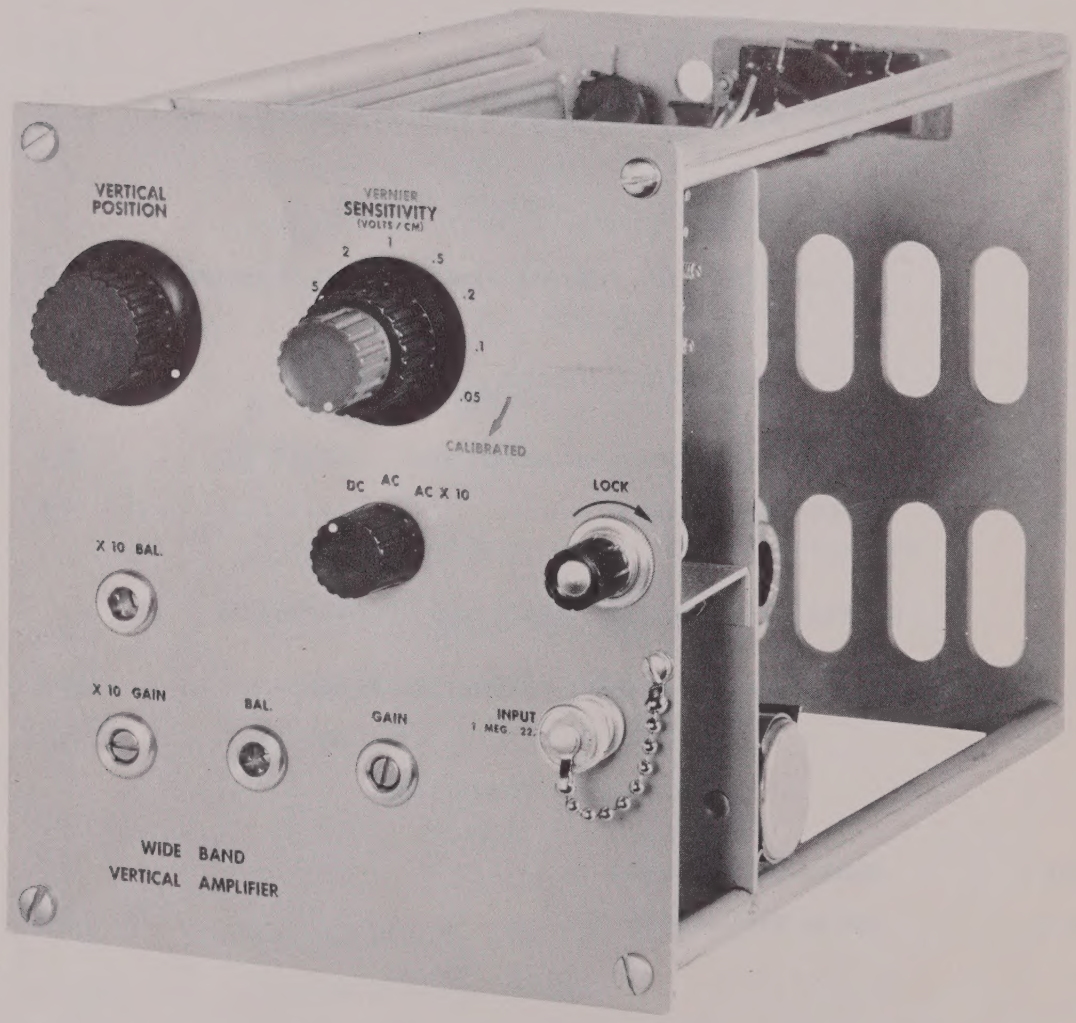


FIGURE 1-1. PREAMPLIFIER, MODEL 1804-8

HP162F
AM-3568/USM

SECTION 1

GENERAL INFORMATION

1-1. FUNCTIONAL DESCRIPTION.

The Hickok Model 1804-8 Wide Band-High Gain Preamplifier is a plug-in unit designed for use with the Model 1804A and the Model 1807 Oscilloscopes. It is used for viewing low level, high frequency waveforms on the oscilloscope.

Complete operational information on the Model 1804-8 is given in Section 3 of this manual.

1-2. CHANGES.

At the time of publication of this manual no modifications had been made to the equipment. A supplement or change sheet may be included with this manual to reflect any changes required to make this manual apply to the instrument with which it is shipped.

1-3. QUICK REFERENCE DATA.

a. TEMPERATURE AND HUMIDITY.

This equipment is designed to operate within the accuracies specified herein over the entire temperature range from minus 28°C to plus 50°C, with a relative humidity of 99 percent.

When reference is made to temperature and humidity ranges of this paragraph, the following shall apply: Range I shall be from plus 15°C to plus 35°C with a relative humidity not greater than 75 percent; Range II shall be from 0°C to plus 50°C with a relative humidity not greater than 90 percent; Range III shall be from minus 28°C to plus 50°C with a relative humidity of not greater than 99 percent.

b. COMPOSITION.

The Model 1804-8 contains a single amplifier and includes attenuators and vertical positioning circuits.

c. AMPLIFIER.

The pass-band of the amplifier is from dc to higher than 60 mc(3db).

d. BANDWIDTH.

When used with the Model 1804A oscilloscope the bandwidth of the Model 1804-8 is from dc to at least 15 mc. When used with the Model 1807 oscilloscope the bandwidth of the Model 1804-8 is from dc to at least 30 mc.

e. SQUARE WAVE RESPONSE.

Permits faithful reproduction of square waves having 0.05 usec rise time over the frequency range of 1 cps to 1 mc.

f. RISE TIME.

The rise time of the Model 1804-8 is such as to permit an overall vertical channel rise time of less than 0.023 usec when used with the Model 1804A oscilloscope, and less than 0.012 usec when used with the Model 1807 oscilloscope.

g. SENSITIVITY.

The sensitivity of the Model 1804-8 is from 0.005 volts/cm to 50 volts/cm for both ac and dc coupling.

A combined ac and dc voltage up to 600 volts will not damage the equipment.

h. INPUT IMPEDANCE.

1 Megohm ±10% shunted by 22 picofarads on all sensitivity ranges.

i. ATTENUATORS.

Nine calibrated ranges in 1-2-5-10 sequence from 0.05 volts/cm to 20 volts/cm (0.005 to 2 volts/cm with AC-DC switch on AC X10 position) and a continuous uncalibrated vernier adjustment between ranges and to at least 40 volts/cm.

j. VERTICAL POSITIONING.

A vertical positioning control is provided for the vertical positioning of any signal within the working range of the equipment at any point within the workable area of the cathode ray tube.

k. VOLTAGE ACCURACY AND LINEARITY.

With the attenuator controls set for maximum sensitivity with either ac or dc coupling, the accuracy on all other calibrated ranges for any trace deflection within the working area of the crt face is 3 percent or better except that the accuracy over temperature and humidity Range III of paragraph 1-3a is 5 percent or better.

l. GENERAL.

Power - Supplied by oscilloscope.

Weight - 4 pounds, 10 ounces.

Dimensions - 11-1/4"L x 7"H x 6"W

TABLE 1-1. LIST OF EQUIPMENT SUPPLIED

Quant. per Equip.	Nomenclature	Model No. or Part No.	Height (inches)	Width (inches)	Depth (inches)	Volume (cu. inches)	Weight (lbs. &oz.)
1	Wide Band - High-Gain Preamplifier	1804-8	7	6	11-1/4	470	4 lbs., 10 oz.
2	Technical Manual	2490-437	11-1/2	8			

SECTION 2

INSTALLATION

2-1. POWER REQUIREMENTS.

All operating voltages required by the Model 1804-8 Preamplifier are supplied by the associated oscilloscope with which it is used.

2-2. INSTALLATION.

To install the Model 1804-8 preamplifier in the oscilloscope, slide it into the front-panel opening of the oscilloscope in the right-hand corner of the front panel. Seat the unit securely and lock it in place to assure good electrical connection.

2-3. INSPECTION AND ADJUSTMENT.

Before placing the preamplifier in operation, visually inspect it for any physical damage such as broken or loose knobs, loose tube retainers, cracked or broken vacuum tubes, etc.

Install the Model 1804-8 in an oscilloscope and turn the oscilloscope power on. All adjustments have been made and preset at the factory, so no preoperational calibration should be necessary. If, however, it is determined that adjustment is required refer to Section 6 of this manual for proper adjustment and recalibration procedures.

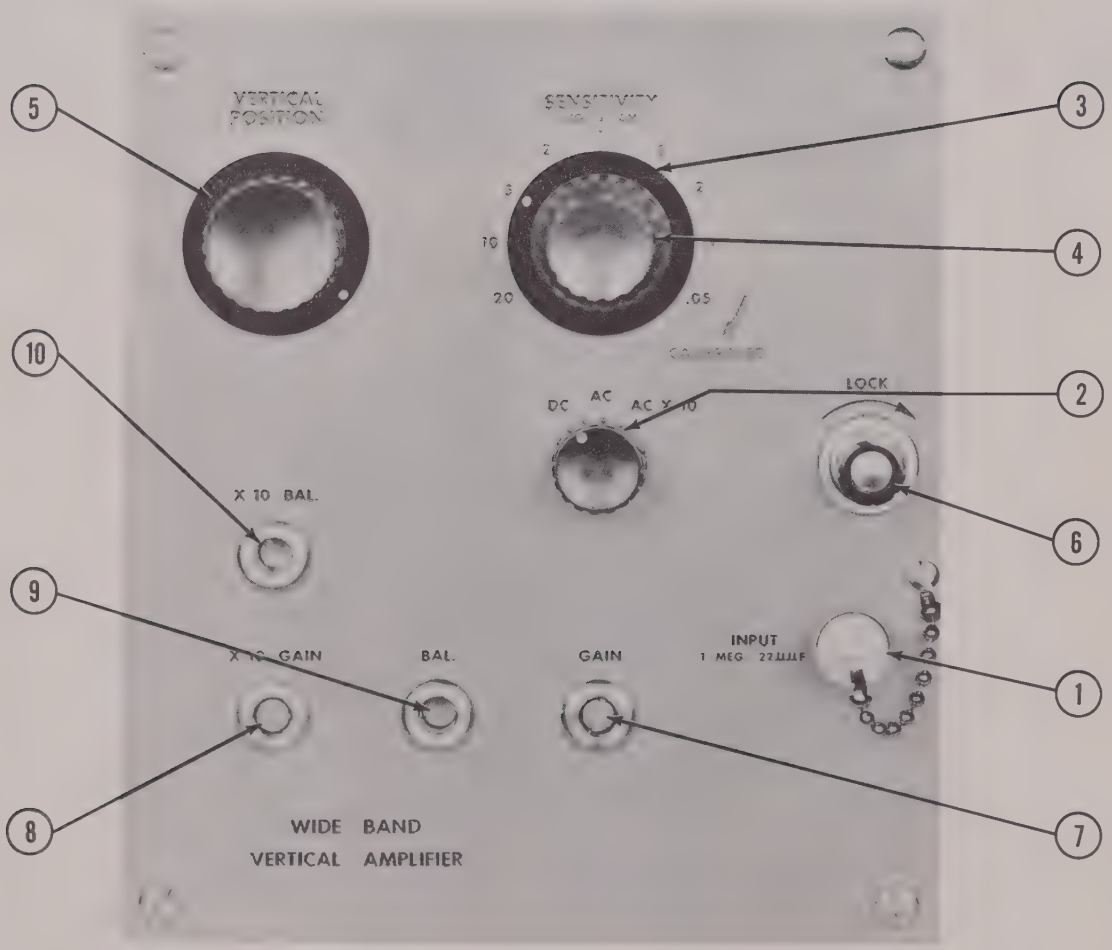


FIGURE 3-1. DESCRIPTION OF FRONT PANEL CONTROLS AND CONNECTORS

SECTION 3

OPERATORS SECTION

3-1. FUNCTIONAL DESCRIPTION.

The amplifiers of the Model 1804-8 Preamplifier are dc coupled. However, an internal coupling capacitor can be switched into these circuits in series with the INPUT connector to provide ac coupling of the input signal. The dc coupling should be used for viewing long pulses and square waves below 100 cps, since such signals are distorted by the time constant of the ac coupling circuit. Also, dc coupling should be used when the dc component is an important part of the signal. The ac coupling is intended for viewing ac components superimposed upon large dc voltages. Since the coupling capacitor blocks the dc component, sensitivity can be selected regardless of the dc level.

In the AC X10 position, additional ac coupled amplifiers are inserted in the circuit. This position should be used for viewing low level ac signals which do not provide adequate deflection on the ac range.

3-2. DESCRIPTION OF FRONT PANEL CONTROLS AND CONNECTORS.

Figure 3-1 illustrates the front panel controls and connectors of the Model 1804-8 preamplifier. The following is a description of these controls and connectors:

① INPUT connector. BNC connector for input of waveforms to be displayed on oscilloscope cathode ray tube.

② AC-DC switch. Provides for AC or DC coupled input and AC X10 gain.

③ SENSITIVITY (Volts/Cm) switch. Selects calibrated vertical deflection sensitivities when the VERNIER control is set at the CALIBRATED position (fully clockwise).

④ VERNIER control. (Red inner knob). Provides uncalibrated variable deflection sensitivities between settings of the SENSITIVITY switch when turned counter-clockwise. (Up to 50 volts/cm for SENSITIVITY switch setting of 20).

⑤ VERTICAL POSITION control. Positions the trace vertically on the cathode ray tube.

⑥ LOCK. Secure the unit in place.

3-3. DESCRIPTION OF FRONT PANEL CALIBRATION CONTROLS.

⑦ GAIN adjustment. Screwdriver adjustment to set proper amount of vertical deflection indicated by the setting of the SENSITIVITY switch.

⑧ X10 GAIN. Screwdriver adjustment to set proper amount of vertical deflection as indicated by the setting of the SENSITIVITY switch with the AC-DC switch set to AC X10.

⑨ BAL. Screwdriver adjustment to set amplifier balance so that the trace does not shift vertically as the VERNIER control is rotated when the AC-DC switch is in either the AC or DC position.

⑩ X10 BAL. Screwdriver adjustment to set amplifier balance so that the trace does not shift vertically as the VERNIER control is rotated when the AC-DC switch is in the AC X10 position.

3-4. DEFLECTION FACTOR.

To assure the correct deflection factor as indicated by the setting of the SENSITIVITY control, the VERNIER control must be turned fully clockwise to the CALIBRATED position.

3-5. INPUT COUPLING.

When the AC-DC switch is in the AC position, a capacitor is placed in series with the input connector to block the DC component of the displayed waveform. This is done when the AC-DC switch is in either the AC or the AC X10 position.

3-6. ADJUSTMENT OF PROBE.

Probe compensation is a function of the input capacitance of the preamplifier. If the compensation is incorrect, frequency response will be affected.

To compensate for various input capacitances from one instrument to another, a trimmer adjustment is provided in the probe. To make this adjustment, set the calibrator controls of the oscilloscope to display several cycles of the waveform at a suitable amplitude when the probe tip is touched to the calibrator connector. Adjust the probe capacitor to obtain a flat top on the square wave as shown in figure 3-2. Instructions for probe adjustment are given in the oscilloscope instruction manual.

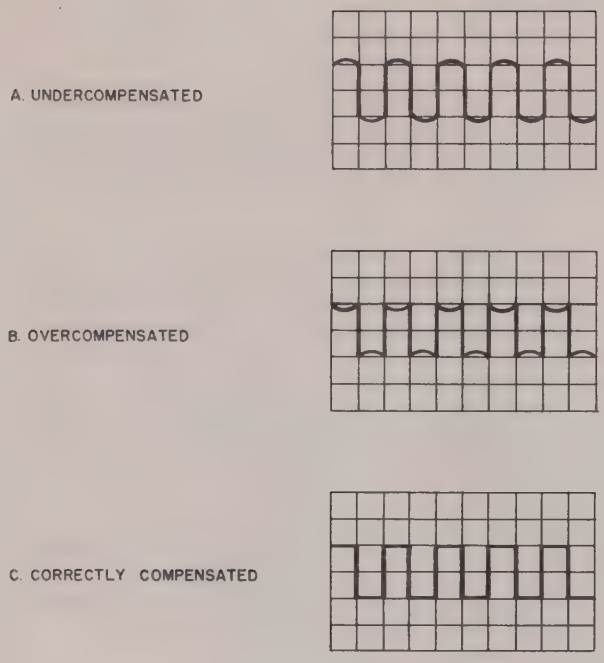


FIGURE 3-2. ADJUSTMENT OF PROBE

3-7. OPERATOR'S MAINTENANCE.

a. OPERATING CHECKS AND ADJUSTMENTS. The calibration of the four front panel calibration controls should be checked periodically by the operator. The function of these four controls is explained in paragraph 3-3. The following is the procedure for determining if these controls are in need of adjustment, and the adjustment procedure:

(1) BAL. adjustment - Need for recalibration of the BAL. adjustment is indicated when the trace shifts vertically as the VARIABLE control is rotated when the AC-DC switch is in either the AC or DC position. BAL. adjustment is accomplished in the following manner:

Free run sweep.

Set AC-DC switch to AC.

Rotate the VARIABLE control back and forth and adjust the BAL. adjustment until the trace does not shift with the rotation of the VARIABLE control.

(2) X10 BAL. adjustment - Need for recalibration of the X10 BAL. adjustment is indicated when the trace shifts vertically as the VARIABLE control is rotated when the AC-DC switch is in the AC X10 position. X10 BAL. adjustment is accomplished in the following manner:

Free run sweep.

Set AC-DC switch to AC X10.

Rotate the VARIABLE control back and forth and adjust the X10 BAL. adjustment until the trace does not shift with rotation of the VARIABLE control.

(3) GAIN adjustment - Need for recalibration of the GAIN adjustment is indicated when the vertical deflection in volts/cm (or mv/cm) does not agree with the value of a known input with the AC-DC switch in the AC or DC position. GAIN adjustment is accomplished in the following manner:

Set AC-DC switch to DC.

Set SENSITIVITY control to 0.05 (VARIABLE control fully CW).

Connect a 200 millivolt square wave from the calibrator and adjust GAIN adjustment for exactly 4 cm of vertical deflection.

(4) X10 GAIN adjustment - Need for recalibration of the X10 GAIN adjustment is indicated when the vertical deflection in volts/cm (or mv/cm) does not agree with the value of a known input with the AC-DC switch in the AC X10 position. X10 GAIN adjustment is accomplished in the following manner:

Set the AC-DC switch to AC X10.

Set SENSITIVITY control to 0.05 (VARIABLE control fully CW).

Connect a 20 millivolt square wave from the calibrator and adjust X10 GAIN adjustment for exactly 4 cm of deflection.

b. EMERGENCY MAINTENANCE. In an emergency, operating personnel can replace tubes listed in Table 3-1. Overall operation of the preamplifier will not be seriously degraded, however, a technician should check the indicated adjustment as soon as possible thereafter.

TABLE 3-1. REQUIRED ADJUSTMENTS FOLLOWING VACUUM TUBE REPLACEMENT

VACUUM TUBE	FUNCTION	ADJUSTMENT
V801	"A" section-Input Cathode Follower	Input Capacitance per paragraph 6-9.
	"B" section-X10 Amplifier	Low Frequency Response per paragraph 6-12.
		X10 Gain per paragraph 3-7a(4).
V802	"A" section-X10 Amplifier "B" section-X10 Cathode Follower	X10 High Frequency Compensation per paragraph 6-13.
		X10 Gain per paragraph 3-7a(4).
V803	Input Amplifier	High Frequency Compensation per paragraph 6-13.
		Gain Adjustment per paragraph 3-7a(3).
		Bal. Adjustment per paragraph 3-7a(1).
		X10 Bal. Adjustment per paragraph 3-7a(2).
V804	Constant Current Generator	None
V805	Output Cathode Follower	Low Frequency Response per paragraph 6-12.
		High Frequency Compensation per paragraph 6-13.
		Bal. Adjustment per paragraph 3-7a(1).
		X10 Bal. Adjustment per paragraph 3-7a(2)

SECTION 4

PRINCIPALS OF OPERATION

4-1. OVERALL FUNCTIONAL DESCRIPTION.

The Model 1804-8 is a preamplifier designed specifically for use with the Hickok Model 1807 oscilloscope. The wide pass-band and high gain of this preamplifier enables the user to view high frequency waveforms of very low amplitude.

The functional block diagram, Figure 4-1, shows the major circuit configuration of the Model 1804-8.

An input signal is applied to the Input Cathode Follower (V801A) through a compensated attenuator network, the attenuation ratio of which is selected by the setting of the SENSITIVITY switch.

This attenuated signal is then applied to the Amplifier/Phase Inverter stage (V803) either directly when the AC-DC switch is in the AC or DC position, or through an amplifier with a fixed gain of ten (10) when the AC-DC switch is in the AC X10 position. The signal is then applied to the input of the oscilloscope vertical amplifier from the Output Cathode Follower.

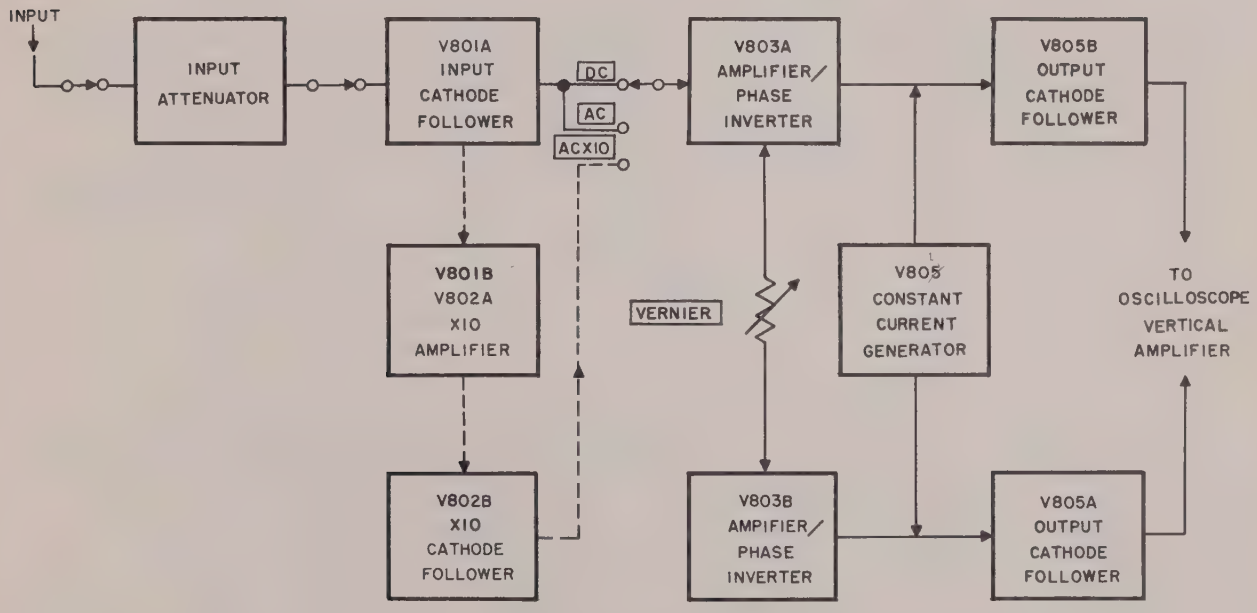


FIGURE 4-1. FUNCTIONAL BLOCK DIAGRAM

4-2. ATTENUATOR NETWORK.

Figure 4-2 is a partial functional schematic of the attenuator network. Two attenuator legs are shown in this illustration, Figure 4-2A is the attenuation leg when the SENSITIVITY switch is in the .05 V/CM position and Figure 4-2B is a generalized schematic of any of the other legs. The circuit inside the broken line comprises the attenuator network.

Figure 4-2A illustrates the most sensitive position of the SENSITIVITY switch. There is, for all practical purposes, no attenuation of the input signal in this position. The 0.7 - 3 pf capacitor after the RC network, is common in all positions of the SENSITIVITY switch but is adjusted for an input capacitance of approximately 20 pf with the SENSITIVITY switch in the .05 V/CM position.

The attenuator Input Capacitance adjustment and the attenuator Frequency Compensation adjustment are called out in Figure 4-2B. These are adjusted in each attenuator leg for proper compensation of capacitance and frequency. C_X and R_X are the attenuator components that determine the attenuation ratio of each leg of the network from .1 V/CM to 20 V/CM.

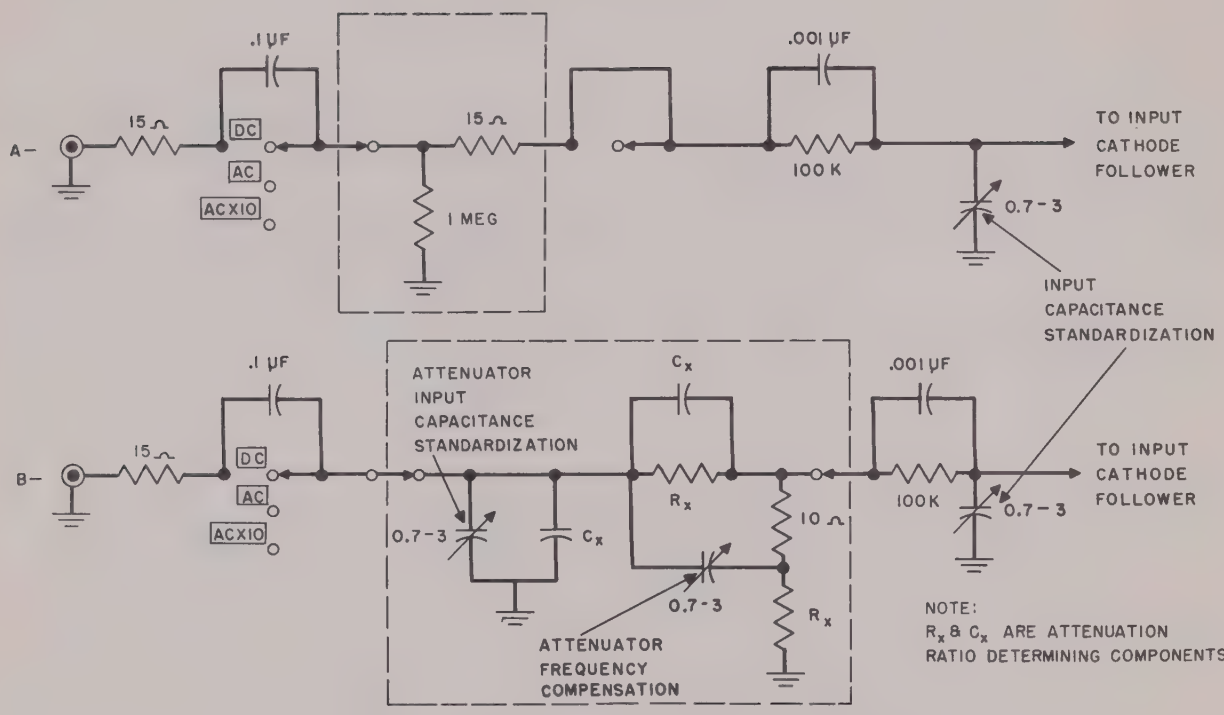


FIGURE 4-2. ATTENUATOR NETWORK FUNCTIONAL SCHEMATIC DIAGRAM

4-3. INPUT CATHODE FOLLOWER AND X10 AMPLIFIER.

Figure 4-3 is a simplified schematic diagram of the Input Cathode Follower V801A, the X10 Amplifier consisting of V801B, V802A and its associated cathode follower V802B.

The attenuated input signal is applied to the grid of V801A, and the resultant signal at the cathode is applied to the Amplifier/Phase Inverter stage through the AC-DC switch. When the AC-DC switch is in the AC X10 position, the signal is applied to the X10 Amplifier V801B and V802A. This signal is then amplified and fed through the X10 Amplifier Cathode Follower V802B to the input of the Amplifier/Phase Inverter stage through the AC X10 position of the AC-DC switch.

4-4. AMPLIFIER/PHASE INVERTER.

V803 and its associated components form an Amplifier/Phase Inverter stage which produces a signal at the plate of V803A which is 180° out of phase with the incoming signal, and a signal at the plate of V803B which is in phase with the incoming signal. (Refer to Figure 4-4).

4-5. CONSTANT CURRENT GENERATOR AND OUTPUT CATHODE FOLLOWER.

Because of the small plate load resistors of V803 (refer to Figure 4-4) the signal at the plates is at a very high dc level (approximately +105 volts). V804 is used as a Constant Current Generator to reduce this dc level.

A negative feedback current is developed through the large cathode resistors of V804 causing a constant current through the 200K plate load resistors of V804. This constant current produces the desired voltage drop across these resistors and the resultant dc level at the grids of the Output Cathode Follower is approximately -5 volts.

The output signal is applied to the oscilloscope vertical amplifier through the Output Cathode Follower V805.

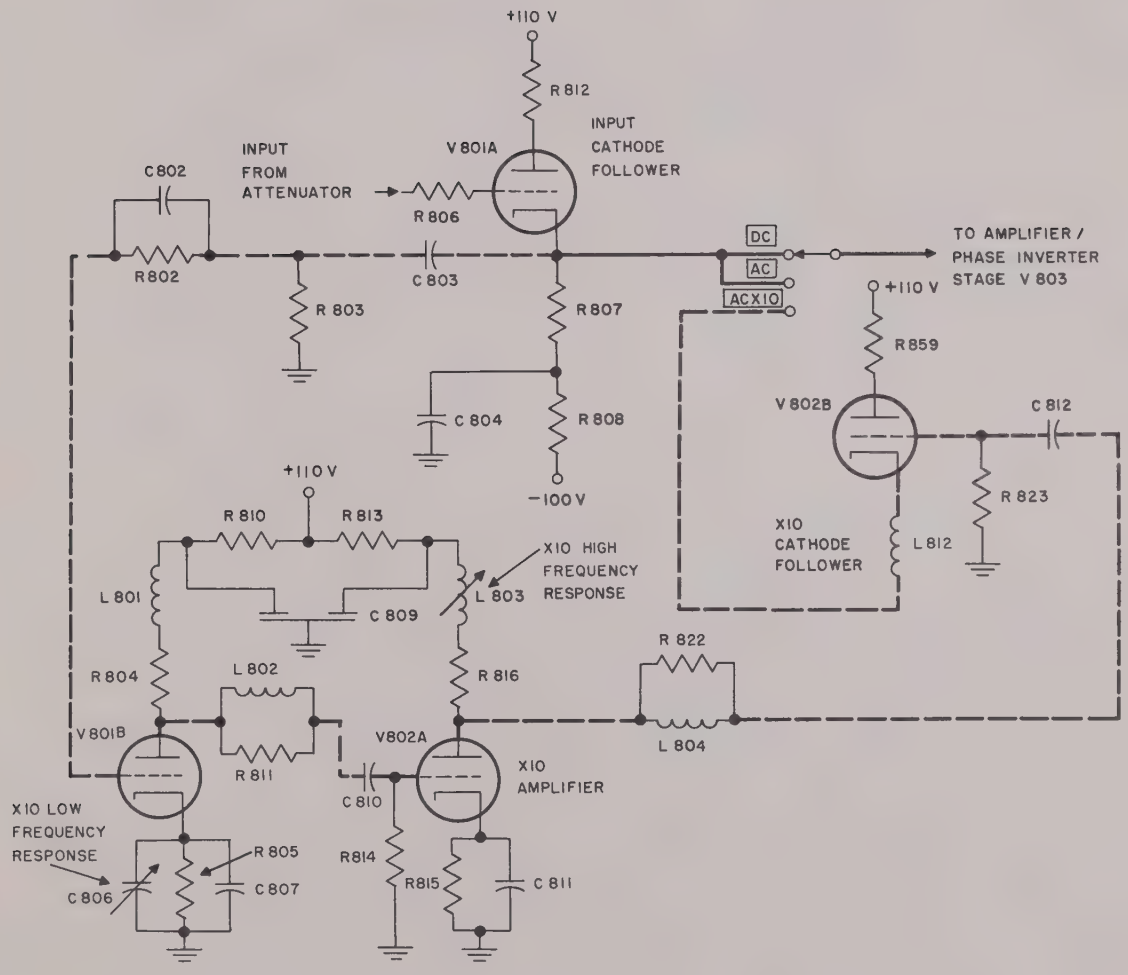


FIGURE 4-3. INPUT CATHODE FOLLOWER AND X10 AMPLIFIER

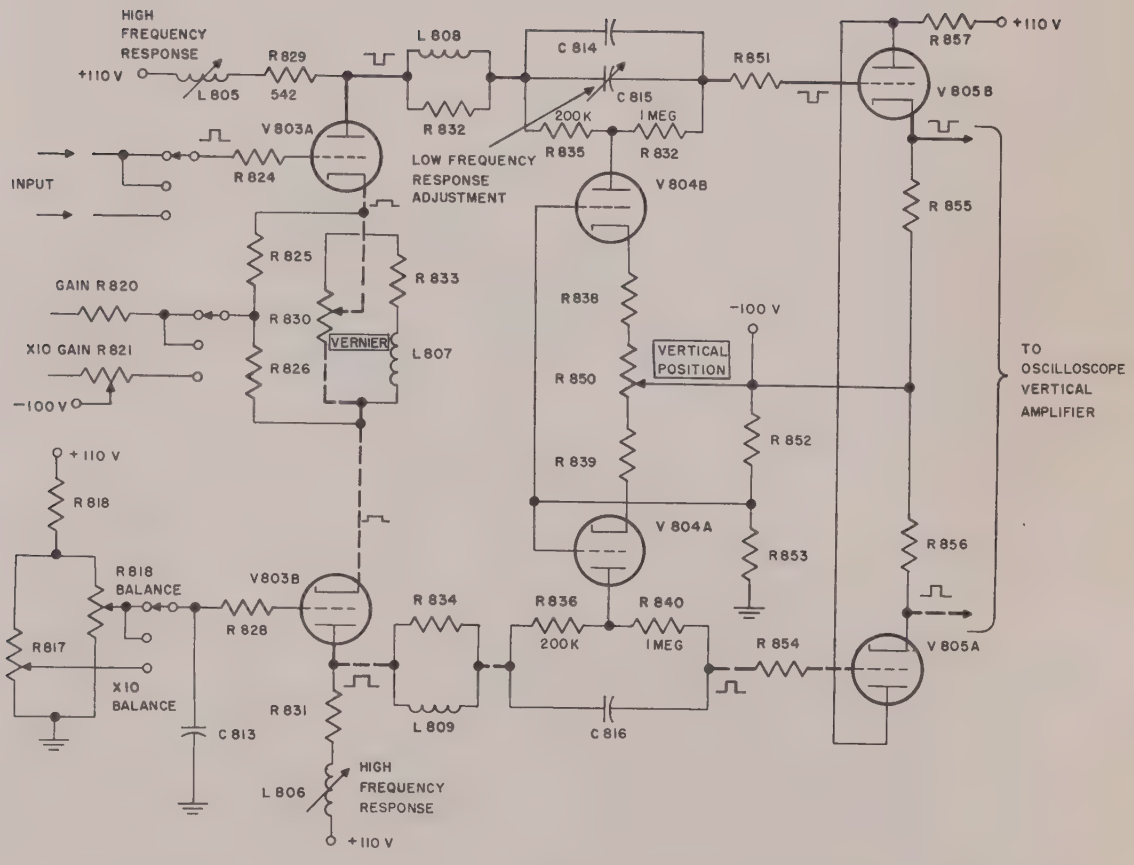


FIGURE 4-4. AMPLIFIER/PHASE INVERTER SIMPLIFIED SCHEMATIC DIAGRAM

SECTION 5

TROUBLE SHOOTING

A thorough understanding of the circuits in this instrument is a valuable aid in trouble shooting. Study SECTION 4, PRINCIPLES OF OPERATION, before starting with the trouble shooting or repair procedures.

TABLE 5-1. LIST OF TEST EQUIPMENT AND SPECIAL TOOLS

Type Instrument	Required Characteristics	Application	Suggested Instrument
VOM	1. Voltage Range: 1 to 400 volts 2. Accuracy: 1% 3. Resistance Range: 100 megohms 4. Input Resistance: 20,000 Ohms/ Volt DC	Voltage and Resistance Measurements	Hickok Model 456
Oscilloscope	1. Calibrated vertical and horizontal deflection. 2. Input Impedance: 1 megohm/30 pf.	Visual waveform measurement	AN/USM-105A AN/USM-140A Hickok Model 1805 or 1805A
Vertical Plug-in Extender	See Figure 5-1	Operation of preamplifier outside of oscilloscope.	See Figure 5-1.

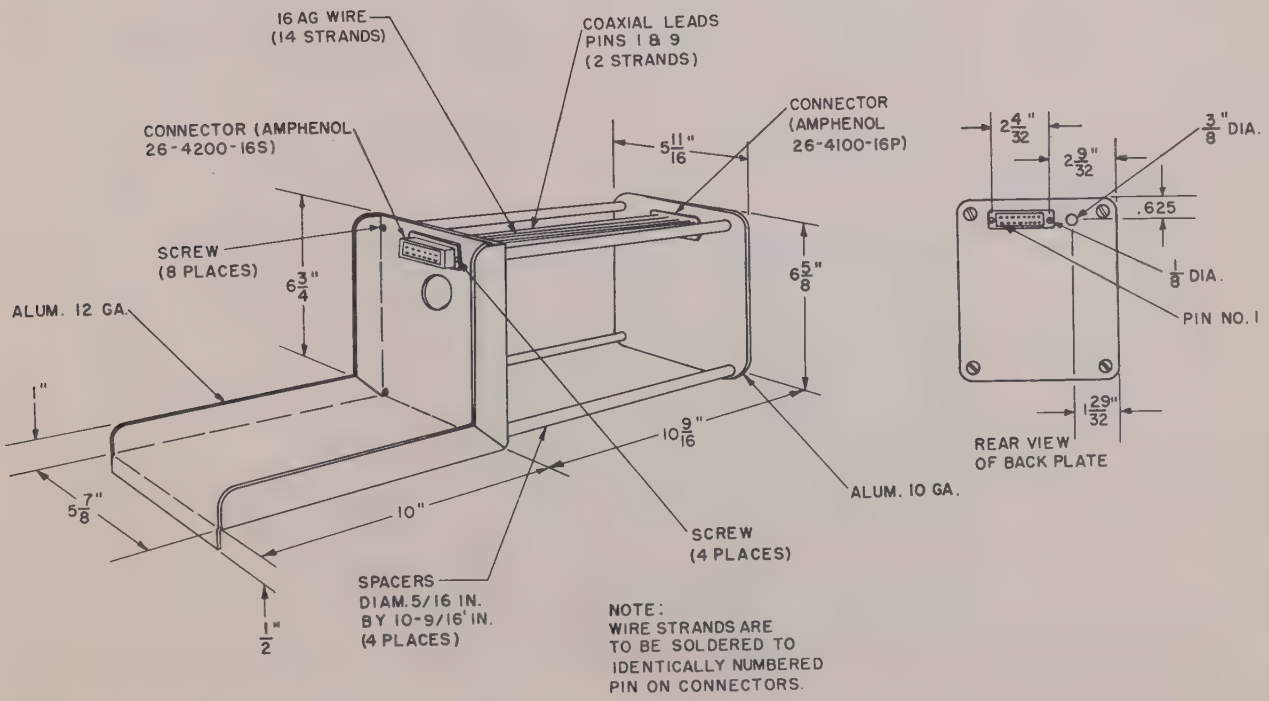


FIGURE 5-1. VERTICAL PLUG-IN EXTENDER

5-1. INTRODUCTION.

The Model 1804-8 Preamplifier forms an integral part of the oscilloscope with which it is used. All vertical input signals are first applied to the Model 1804-8 and then to the associated oscilloscope, therefore particular attention should be given to the control settings of both the Model 1804-8 and the oscilloscope.

This manual outlines trouble shooting procedures for the Model 1804-8 Preamplifier only. For trouble shooting procedures for the oscilloscope with which the 1804-8 is to be used, refer to the troubleshooting section of the oscilloscope instruction manual.

5-2. OVERALL TROUBLE SHOOTING.

Before proceeding with any trouble shooting procedures for the Model 1804-8, ascertain that the oscilloscope is in good working condition. Check oscilloscope operating voltages and Reference Standards as outlined in the oscilloscope instruction manual. When it has been determined that the operation of the oscilloscope is satisfactory visually inspect the Model 1804-8 for any obvious defects, such as unseated vacuum tubes, loose wires etc.

Table 5-2 lists some of the most common troubles that may occur in the Model 1804-8. This chart is merely a guide to finding the section or specific part of the circuit that is not functioning properly. When the trouble has been pin-pointed to a specific circuit or section of a circuit the schematic diagram should be used as a trouble shooting guide. Voltage and resistance measurements and waveform measurements are shown on the schematic and should be used to determine the specific component or components that are at fault.

TABLE 5-2. TROUBLE SHOOTING CHART

TROUBLE	PROBABLE CAUSE	REMEDY
Loss of Trace	Improper Vertical Positioning Control Adjustment.	Adjust Vertical Positioning Control until trace appears on the CRT.
	Improper Vertical Positioning voltages. (Voltage on pins 1 and 9 of the innerconnecting plug must be essentially equal).	Defective tubes. Check V803, V804, and V805 and replace if necessary.
Inability to position trace	Improper vertical positioning voltages.	Defective tubes. Check V803, V804, and V805 and replace if necessary.
	Defective Vertical Positioning control.	Measure for open or short and replace if necessary.
Horizontal trace present but no waveform displayed in AC X10 position.	Defective component in X10 Amplifier section.	Check for defective tubes, open coils, shorted or open capacitor. Replace faulty component. eg: Open coil L801 will open plate line of V801B.
Horizontal trace present but no waveform displayed in any position of the AC-DC switch (AC X10, AC or DC)	Defective component in Amplifier/Phase Inverter stage or Output stage.	If trace can be moved vertically with the vertical position control, check components of the Amplifier/Phase Inverter stage (V803). If trace cannot be moved vertically with the vertical position control, check components of the Output stage (V805). Replace faulty component.
Low Vertical Gain	Gain components out of calibration.	Recalibrate as per calibration instructions. See Paragraph 3-7a(3) and 3-7a(4).
	Defective tube in Preamplifier or Amplifier/Phase Inverter Stage.	Check and replace faulty tube.
Low frequency waveform distortion	Low Frequency Compensation misadjusted.	Recalibrate as per calibration instructions. See Paragraph 6-12.
	Improperly adjusted probe.	Readjust probe as per instructions.

TABLE 5-2. TROUBLE SHOOTING CHART (CONTINUED)

TROUBLE	PROBABLE CAUSE	REMEDY
High frequency waveform distortion	High frequency Peaking coils misadjusted (L805 and L806).	Recalibrate as per calibration instructions. See Paragraph 6-14.
	Shorted or partially shorted peaking coils (L805 and L806).	Check and replace if necessary.
	L807 Defective.	Check and replace if necessary.

5-3. TROUBLE SHOOTING PROCEDURES.

With the signal disconnected, make successive dc measurements. (The dc voltages are shown in the schematic diagram with respect to ground unless otherwise indicated.) If the dc measurement does not agree with the reference on the schematic diagram, the fault or defect lies at this point. Check for defective tube, resistor, capacitor, switch, poor solder joint or loose wire connection. After repair, the waveforms should be as indicated on the schematic.

Using the test oscilloscope, check circuit operation by comparing waveforms, voltage measurements, and resistance measurements obtained with those on the schematic diagram.

Waveforms and voltage measurements called out on the schematic diagram are typical measurements. A slight deviation from these measurements should not be interpreted as a malfunction. Any major deviation from these measurements should be checked and corrected before proceeding with the trouble shooting procedure.

WARNING

TURN INSTRUMENT OFF BEFORE FOLLOWING ANY INSTRUCTION (CALLING FOR DISCONNECTION OF LEADS, REMOVAL OF TUBES, ETC.) WHICH MAY CAUSE CONTACT WITH OFF-GROUND POTENTIALS.

In many cases, instrument failure is caused by faulty vacuum tubes. The best method of determining if a tube is faulty is to replace it with a known tube of the same type.

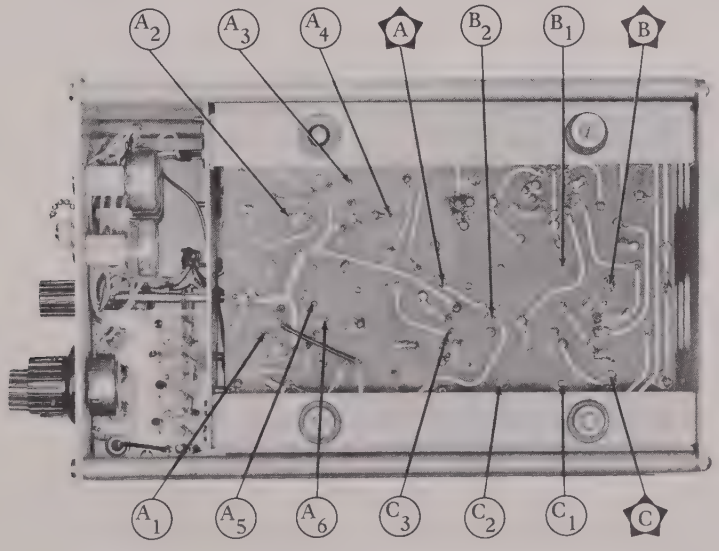


FIGURE 5-2. LOCATION OF TEST POINTS

NOTES

SECTION 6

SERVICE, REPAIR AND RECALIBRATION

6A PREVENTATIVE MAINTENANCE

6-1. INTRODUCTION.

Preventative maintenance for the Model 1804-8 Preamplifier consists mainly of visual inspection for potential sources of trouble. General good-housekeeping techniques such as periodic visual inspection for loose switch knobs, unseated vacuum tubes, loose or frayed wire, etc., will assure long trouble-free operation of the Model 1804-8.

The power supply voltages of the oscilloscope should be checked periodically to assure that the power supply voltages are operating within their rated accuracy.

6B REFERENCE STANDARDS

6-2. GENERAL.

Reference Standards are included in this manual so that they may be used as guides to determine that the instrument is operating at specified accuracies (para. 1-3). After repair of the instrument the repaired circuit or circuits should be recalibrated per the applicable portion of the Adjustment and Recalibration procedures outlined in paragraph 6-4. After recalibration, instrument performance should be checked by the procedures outlined in this section.

6-3. TEST EQUIPMENT.

Test equipment required for service and repair of the Model 1804-8 is listed in Table 6-1. Models of test equipment may be substituted for other models having the same characteristics.

TABLE 6-1. TEST EQUIPMENT REQUIRED FOR SERVICE AND REPAIR

EQUIPMENT	REQUIRED CHARACTERISTICS	TO BE USED FOR	MODEL
Square Wave Generator	Output: 1 cps to 1 mc, 75 ohm and 600 ohm output.	Low Frequency Response Check	Hickok Model 1715 or 1715A.
Fast Rise Time Square Wave Generator	Output: 0.4 mc to 1.0 mc. Risetime: 3.0 nanosec.	High Frequency Compensation Check	Tektronix Model 107.
Constant Amplitude Signal Generator	Range: 0.35 to 50 mc. Constant Amplitude Voltage: 1-10 volts peak-to-peak.	Frequency Response Check	Tektronix Model 190A.
20 pf Capacitance Standardizer		Input Capacitance Standardization	Tektronix Model 011-022. (CS20)
10:1 Attenuation "T" Pad	Attenuation Ratio: 10:1 Impedance: 52 ohms.	Frequency Response Check	Tektronix Model B52 T10.
Voltmeter Calibration Generator	Output Voltage: 0.01 to 50 volts @400 cps. Accuracy: ± 0.25%.	Attenuator Calibration	Hewlett-Packard Model 738AR.
Vertical Plug-in Extender	See Figure 5-1.	Operation of Preamplifier outside of oscilloscope	See Figure 5-1.

6-4. PERFORMANCE TESTS.

Performance tests for the Model 1804-8 are described in paragraphs 6-5 through 6-9.

6-5. ATTENUATOR CALIBRATION.

The calibration of the input attenuators of the Model 1804-8 is measured in the following manner:

a. Connect the output of the Voltmeter Calibration Generator to the INPUT connector of the Model 1804-8 with a BNC-GR cable. Set the FUNCTION switch of the Voltmeter Calibration Generator to 400 cycles peak-to-peak.

b. Set the oscilloscope SWEEP TIME to 1 ms/cm. Set the GAIN adjustment of the Model 1804-8 so that 0.2 volts from the Voltmeter Calibration Generator gives exactly 4 centimeters of vertical deflection with the Model 1804-8 SENSITIVITY switch set to 0.05 V/CM.

c. Set the output of the Voltmeter Calibration Generator to the following settings for the sensitivity to be checked. The vertical deflection should be within the indicated values:

SENSITIVITY	VOLTMETER CALIBRATION GENERATOR	VERTICAL DEFLECTION
0.05	0.2	4.00
0.10	0.3	2.91 to 3.09
0.20	0.5	2.42 to 2.58
0.50	1.0	1.94 to 2.06
1.00	3.0	2.91 to 3.09
2.00	5.0	2.42 to 2.58
5.00	10.0	1.94 to 2.06
10.00	30.0	2.91 to 3.09
20.00	50.0	2.42 to 2.58

d. Set the SENSITIVITY switch of the Model 1804-8 to 0.05 V/CM and turn the VERNIER control fully counterclockwise. Set the Voltmeter Calibration Generator to 0.05 volts. The deflection should be less than 4 centimeters.

e. Set the Voltmeter Calibration Generator to the following settings. Set the AC-DC switch of the Model 1804-8 to AC X10. The vertical deflection should be within the values listed.

SENSITIVITY	VOLTMETER CALIBRATION GENERATOR	VERTICAL DEFLECTION
0.020	0.01	1.94 to 2.06
0.010	0.03	2.91 to 3.09
0.005	0.05	2.42 to 2.58

6-6. SENSITIVITY, VOLTAGE ACCURACY, AND LINEARITY.

The dc sensitivity, voltage accuracy, and linearity of the cathode ray tube is measured with the same test equipment setup as in paragraph 6-5 (Attenuator Calibration) except that the Voltmeter Calibration Generator shall be set to dc+ and the input of the Model 1804-8 shall be set on dc coupling.

a. Set the oscilloscope SWEEP MODE control to FREE RUN to obtain a base line reference trace.

b. Set the Voltmeter Calibration Generator to zero output and position the oscilloscope trace on the lowest graticule line.

c. Set the Model 1804-8 SENSITIVITY switch and the Voltmeter Calibration Generator output switch as shown below. The trace should be displaced upward the indicated number of centimeters.

SENSITIVITY	VOLTMETER CALIBRATION GENERATOR	VERTICAL DEFLECTION
0.05	0.10	1.94 to 2.06
0.10	0.30	2.91 to 3.09
0.20	0.50	2.42 to 2.58
0.50	0.50	0.97 to 1.03
0.50	1.00	1.94 to 2.06
0.50	2.00	3.88 to 4.12
1.00	3.00	2.91 to 3.09
2.00	5.00	2.42 to 2.58
5.00	10.00	1.94 to 2.06
10.00	30.00	2.91 to 3.09
20.00	50.00	2.42 to 2.58

d. Rotate the VERNIER control for minimum sensitivity (full CCW). With a calibrator voltage of 100.0 volts, the vertical deflection should be 2 centimeters or less.

6-7. SQUARE WAVE RESPONSE.

The square wave response of the Model 1804-8 preamplifier is checked in the following manner:

a. Set the Model 1804-8 SENSITIVITY switch to 0.05 V/CM and the AC-DC switch to DC. Connect the 52 ohm output of the Fast Rise Time Square Wave Generator to the INPUT connector of the Model 1804-8 with a 52 ohm BNC-BNC cable and a 52 ohm feed-thru termination. Set the frequency of the Fast Rise Time Square Wave Generator to 1 megacycle.

b. Set the oscilloscope SWEEP TIME switch to INTERNAL SWEEP MAGNIFIER X5. Adjust oscilloscope sweep controls to obtain a stable display.

c. Set the amplitude control of the Fast Rise Time Square Wave Generator to give 4 centimeters of vertical deflection. Measure the 10 to 90 percent rise time of the displayed square wave. Since the Fast Rise Time Square Wave Generator has a rise time of about 3 nanoseconds, the measured rise time should not exceed 0.0124 usec.

d. Switch the Model 1804-8 AC-DC switch to AC X10. Connect the 52 ohm "T" attenuator to the 52 ohm output of the Fast Rise Time Square Wave Generator and set the amplitude control of the generator to give 4 centimeters of vertical deflection. The 10 to 90 percent risetime of the square wave should not exceed 0.015 usec.

e. Set the oscilloscope HORIZONTAL DISPLAY switch to X1 and the SWEEP TIME switch to 0.5 usec/cm. Adjust the oscilloscope sweep controls to obtain a stable display.

f. Observe the quality of the resultant waveform. There should be no noticeable ringing, oscillations, slope, or spurious responses. For the purpose of precise measurement any effect greater than 2 percent will be considered noticeable.

g. Adjust the oscilloscope TRIGGER LEVEL control as far negative as possible and still maintain stable triggering. (Use of the SWEEP MODE control may be necessary). The leading edge of the square wave shall be visible.

h. Connect the Square Wave Generator 600 ohm output to the INPUT connector of the Model 1804-8, and the 75 ohm output to the EXT. SYNC. connector of the oscilloscope. Set the oscilloscope SWEEP TIME switch to 50 usec/cm. Set the frequency of the Square Wave Generator to 5kc. Set the 75 ohm output to maximum and adjust the 600 ohm output to give approximately 4 centimeters of vertical deflection of the displayed square wave.

i. Adjust the Model 1804-8 SENSITIVITY switch to successive steps of less sensitivity and increase the 600 ohm output of the Square Wave Generator simultaneously to maintain approximately constant vertical deflection.

j. Observe the quality of the waveform. There should be no noticeable ringing, oscillations, slope droop, or spurious responses. Check each position of the SENSITIVITY switch. For the purpose of precise measurement any effect greater than 2 percent will be considered noticeable.

6-8. FREQUENCY RESPONSE.

The frequency response of the Model 1804-8 is measured in the following manner:

a. Set the Model 1804-8 SENSITIVITY switch to 0.05 V/CM and the AC-DC switch to AC. Connect the output of the Constant Amplitude Signal Generator to the Model 1804-8 INPUT connector.

b. Adjust the oscilloscope sweep controls for a free-running display. Adjust the output amplitude of the Constant Amplitude Signal Generator for exactly 4 centimeters of vertical deflection at 50kc.

c. Change the frequency of the Constant Amplitude Signal Generator to 30 megacycles. The vertical deflection of the 30 megacycle sine wave should be at least 2.8 centimeters.

d. Set the Model 1804-8 AC-DC switch to AC X10. Connect the 10:1 "T" attenuator between the output of the Constant Amplitude Signal Generator and the Model 1804-8 INPUT connector. Adjust the output amplitude of the Constant Amplitude Signal Generator for exactly 4 centimeters of vertical deflection.

e. Change the frequency of the Constant Amplitude Signal Generator to 24 megacycles. The vertical deflection of the 24 megacycle sine wave should be at least 2.8 centimeters.

6-9. VERTICAL POSITION RANGE.

The vertical position range of the Model 1804-8 is checked with the same equipment setup as that for paragraph 6-5 (Attenuator Calibration).

Set the output of the Voltmeter Calibration Generator to 0.05 volts. Set the Model 1804-8 SENSITIVITY switch to 0.05 V/CM. Adjust the VERTICAL POSITION control from one extreme to the other. The signal should move beyond the uppermost and the lowest graticule marking in both the upward and downward direction.

6C MAINTENANCE REPAIR

Complete adjustment and recalibration of the Model 1804-8 Preamplifier is described in the following paragraphs. Table 3-1 lists the required adjustments in the replacement of vacuum tubes. Table 6-1 lists the test equipment required for complete recalibration of the instrument.

6-10. PREAMPLIFIER INPUT CAPACITANCE ADJUSTMENT.

Set the controls of the Model 1804-8 as follows:
AC-DC . . . . . DC

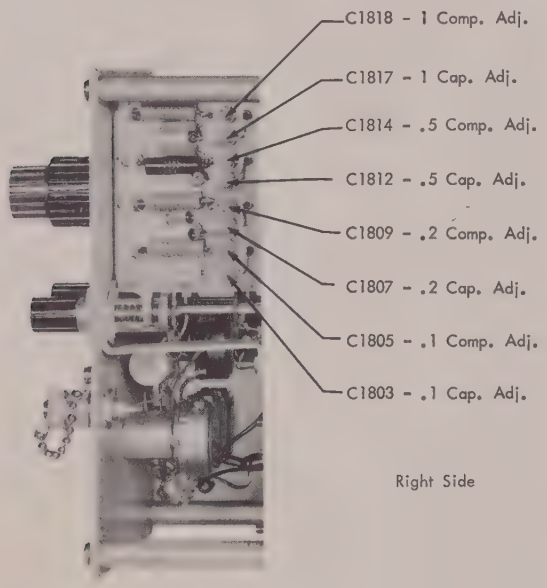
SENSITIVITY . . . . . 0.05 V/CM

Apply a 0.2 volt square wave from the oscilloscope square wave calibrator through the 20 pf Capacitance Standardizer to the INPUT connector of the Model 1804-8. Adjust the oscilloscope sweep controls for a stable display of a few cycles of the square wave. Adjust C819 for a flat top on the displayed square wave.

6-11. ATTENUATOR COMPENSATION ADJUSTMENT.

Using the output from the oscilloscope square wave calibrator (be sure to remove 20 pf capacitance standardizer) adjust the Attenuator Compensation Capacitors (see Figure 6-1) according to the following settings to remove the spike from the leading edge of the displayed square wave.

OSCILLOSCOPE CALIBRATOR SETTING	SENSITIVITY SWITCH SETTING	ADJUST ATTEN. COMP. CAPACITOR
0.2V	0.1 V/CM	C1805
0.5V	0.2 V/CM	C1809
1.0V	0.5 V/CM	C1814
2.0V	1.0 V/CM	C1818
5.0V	2.0 V/CM	C1826
10.0V	5.0 V/CM	C1830
20.0V	10.0 V/CM	C1834
50.0V	20.0 V/CM	C1838


C1818 - 1 Comp. Adj.
C1817 - 1 Cap. Adj.
C1814 - .5 Comp. Adj.
C1812 - .5 Cap. Adj.
C1809 - .2 Comp. Adj.
C1807 - .2 Cap. Adj.
C1805 - .1 Comp. Adj.
C1803 - .1 Cap. Adj.
Right Side

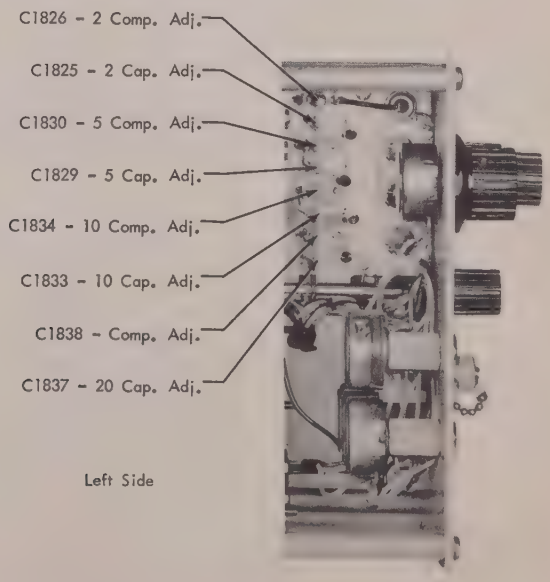

C1826 - 2 Comp. Adj.
C1825 - 2 Cap. Adj.
C1830 - 5 Comp. Adj.
C1829 - 5 Cap. Adj.
C1834 - 10 Comp. Adj.
C1833 - 10 Cap. Adj.
C1838 - Comp. Adj.
C1837 - 20 Cap. Adj.
Left Side

FIGURE 6-1. LOCATION OF ATTENUATOR ADJUSTMENTS

6-12. ATTENUATOR INPUT CAPACITANCE ADJUSTMENT.

Using the output from the oscilloscope square wave calibrator through the 20 pf capacitance standardizer adjust the Attenuator Input Capacitance capacitors according to the following settings for a flat top on the displayed square wave.

OSCILLOSCOPE CALIBRATOR SETTING	SENSITIVITY SWITCH SETTING	ADJUST INPUT CAPACITOR
0.5V	0.1 V/CM	C1803
1.0V	0.2 V/CM	C1807
2.0V	0.5 V/CM	C1812
5.0V	1.0 V/CM	C1817
10.0V	2.0 V/CM	C1825
20.0V	5.0 V/CM	C1829
50.0V	10.0 V/CM	C1833
100.0V	20.0 V/CM	C1837

6-13. LOW FREQUENCY COMPENSATION.

Set the controls of the Model 1804-8 as follows:

AC-DC . . . . . DC

SENSITIVITY . . . . . 0.05 V/CM

Apply a 0.2 volt square wave from the oscilloscope square wave calibrator to the Model 1804-8 INPUT connector. Adjust the oscilloscope sweep control for a stable display of a few cycles of the square wave.

Adjust C815 for a flat top on the displayed square wave.

6-14. HIGH FREQUENCY COMPENSATION.

Set the controls of the Model 1804-8 as follows:

AC-DC . . . . . AC

SENSITIVITY . . . . . 0.05 V/CM

Connect the output of the Fast Rise Time Square Wave Generator to the INPUT connector of the Model 1804-8.

Adjust the frequency of the Fast Rise Time Square Wave Generator to approximately 500kc and adjust the oscilloscope sweep controls for a stable display of a few cycles of the square wave.

Adjust the amplitude of the Fast Rise Time Square Wave Generator for approximately 3 centimeters of vertical deflection of the displayed square wave.

Adjust L805 and L806 for a slight peak on the leading edge of the displayed 500kc square wave.

6-15. X10 HIGH FREQUENCY COMPENSATION.

Set the controls of the Model 1804-8 as follows:

AC-DC . . . . . AC X10

SENSITIVITY . . . . . 0.05 V/CM

Connect the output of the Fast Rise Time Square Wave Generator through the 10:1 attenuator pad to the INPUT connector of the Model 1804-8.

Adjust the frequency of the Fast Rise Time Square Wave Generator to approximately 500kc and adjust the oscilloscope sweep controls for a stable display of a few cycles of the square wave.

Adjust the amplitude of the Fast Rise Time Square Wave Generator for approximately 3 centimeters of vertical deflection of the displayed square wave.

Adjust C806 for a flat top on the displayed square wave.

Adjust L803 for a slight peak on the leading edge of the displayed square wave.

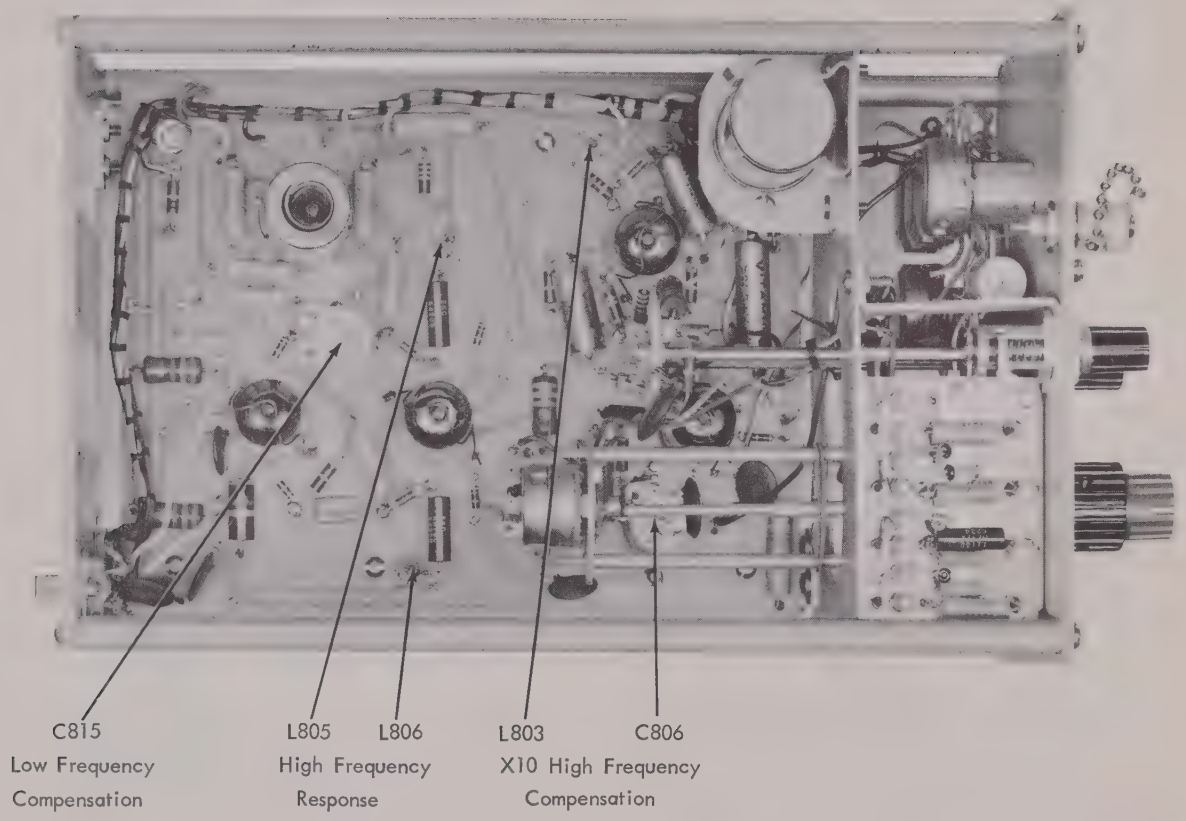
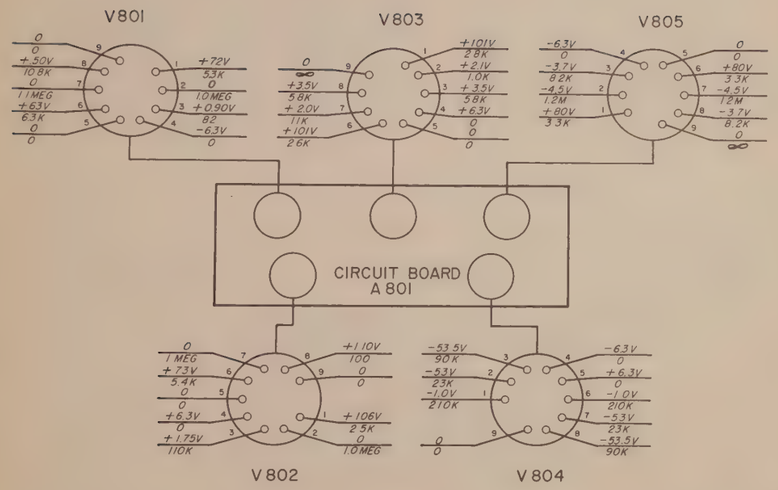
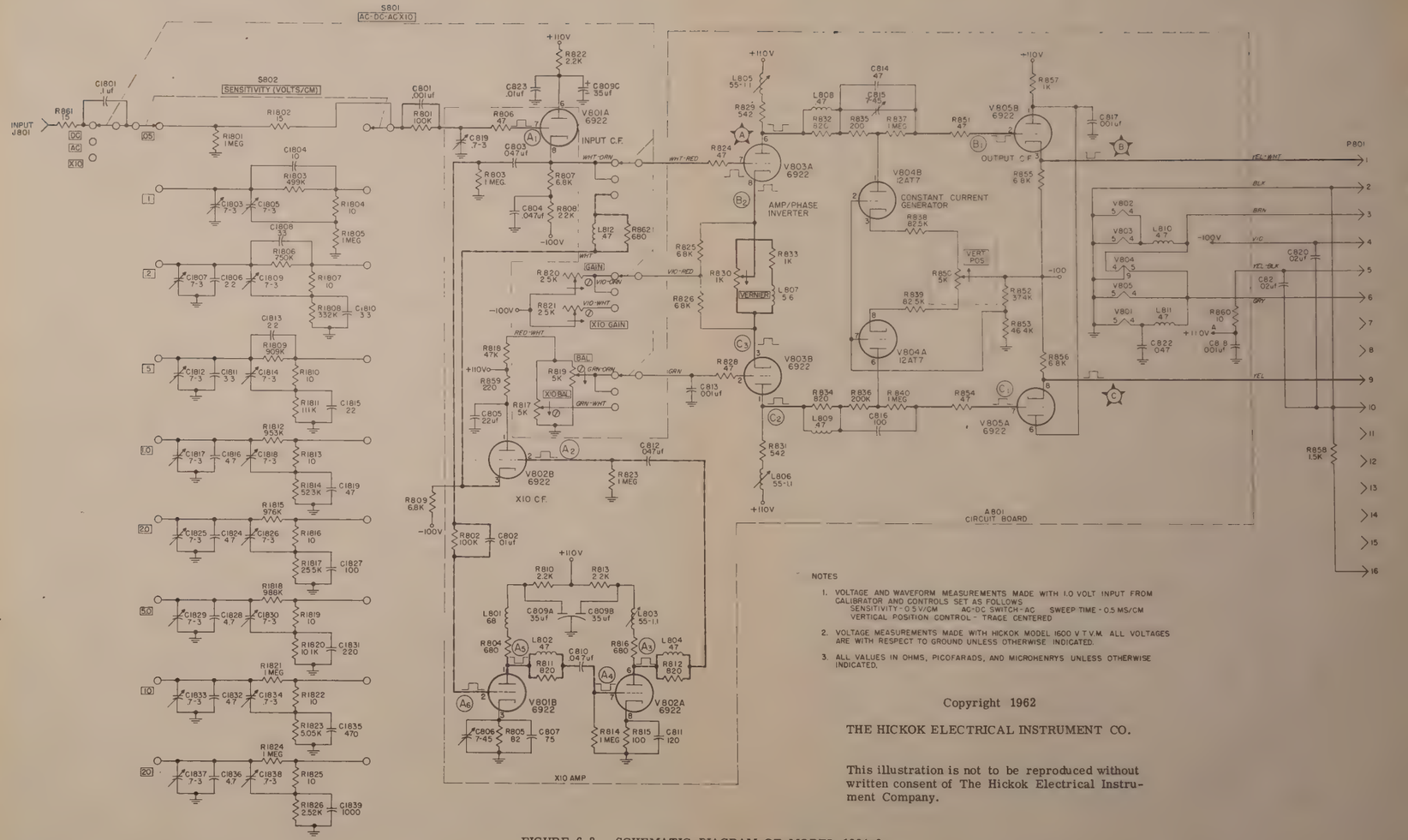


FIGURE 6-2. LOCATION OF ADJUSTMENTS, RIGHT SIDE VIEW

inverted





NOTES

1. VOLTAGE AND WAVEFORM MEASUREMENTS MADE WITH 1.0 VOLT INPUT FROM CALIBRATOR AND CONTROLS SET AS FOLLOWS SENSITIVITY - 0.5 V/CM AC-DC SWITCH - AC SWEEP TIME - 0.5 MS/CM VERTICAL POSITION CONTROL - TRACE CENTERED
2. VOLTAGE MEASUREMENTS MADE WITH HICKOK MODEL 1600 V.T.V.M. ALL VOLTAGES ARE WITH RESPECT TO GROUND UNLESS OTHERWISE INDICATED.
3. ALL VALUES IN OHMS, PICOFARADS, AND MICROHENRYS UNLESS OTHERWISE INDICATED.

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FIGURE 6-3. SCHEMATIC DIAGRAM OF MODEL 1804-8

SECTION 7

PARTS LIST

7-1. INTRODUCTION.

Reference designations are assigned to identify all maintenance parts of the Model 1804-8, Delay Generator. They are used for marking the instrument (adjacent to the part they identify) and are included on the schematics, wiring diagrams and parts list. The letter prefix of a reference designation indicates the kind of part-resistor, capacitor, electron tube, etc. The number differentiates between parts in the same group. Sockets associated with electron tubes, fuses and like items include the reference designation of the associated part and a prefix X.

7-2. MAINTENANCE PARTS LIST.

Table 7-1 lists all maintenance parts for the 1804-8. The table includes a function location for parts. The physical location of parts is illustrated in Figure 7-1 thru 7-4. Manufacturer and type or part number are given for items which have no military designation. Manufacturers addresses are listed in table 7-2.

TABLE 7-1. MAINTENANCE PARTS LIST

REF. DESIG.	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
A801		BOARD, ETCHED CIRCUIT, includes: C802, C803, C805, C806, C807, C810, C811, C812, C813, C814, C815, C816, C817, C818, C819, C822, C823, L801, L802, L803, L804, L805, L806, L808, L809, L810, L811, R802, R803, R804, R805, R806, R811, R814, R815, R816, R818, R822, R823, R824, R825, R826, R828, R829, R831, R832, R834, R835, R836, R837, R838, R839, R840, R851, R852, R853, R854, R855, R856, R857, R859, R860, V801, V802, V803, V804, V805, XV801, XV802, XV803, XV804, XV805 (28569 stk. no. 2420-644)	Figure 7-3.
C801		CAPACITOR, FIXED, CERAMIC: .001 uf, ±20%, 500V, CK60AW102M per MIL-C-11015B	High Frequency Bypass Capacitor. Figure 7-4.
C802		CAPACITOR, FIXED, CERAMIC: .01 uf, ±20%, 500V, CK63AW103M per MIL-C-11015B	X10 High Frequency Bypass Capacitor. Figure 7-3.
C803		CAPACITOR, FIXED, PAPER: .047 uf, ±10%, 200V, CP09A1KC473K3 per MIL-C-25C	X10 Amplifier Coupling Capacitor. Figure 7-3.
C804		CAPACITOR, FIXED, CERAMIC: .047 uf, ±20%, 200V (72982 Type 25V)	Decoupling Capacitor for V801A Cathode. Figure 7-1.
C805		CAPACITOR, FIXED, PAPER: .22 uf, ±10%, 200V, CP09A1KC224K3 per MIL-C-25C	Decoupling Capacitor, for V802B Plate. Figure 7-3.
C806		CAPACITOR, VARIABLE: 7-45 uuf, 500V, CV11C450 per MIL-C-81A	X10 Low Frequency Response Adjustment. Figure 7-3.

TABLE 7-1. MAINTENANCE PARTS LIST (CONTINUED)

REF. DESIG.	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
C807		CAPACITOR, FIXED, MICA: 75 uuf, ±5%, 500V CM15C750JN3 per MIL-C-5B	Bypass Capacitor for V801B Cathode. Figure 7-3.
C808		Not Assigned.	
C809A, B, C		CAPACITOR, FIXED, ELECTROLYTIC: 3X35 uf, 150 V (plug-in type) CE53C350J per MIL-C-62B	Filter Capacitor for V801A, V801B and V802A plates. Figure 7-1.
C810		Same as C803	Coupling Capacitor for V802A. Figure 7-3.
C811		CAPACITOR, FIXED, MICA: 120 uuf, ±5%, 500V CM15C121JN3 per MIL-C-5B	Bypass Capacitor for V802A Cathode. Figure 7-3.
C812		Same as C803	Coupling Capacitor for V802B. Figure 7-3.
C813		CAPACITOR, FIXED, CERAMIC: 1000 uuf, ±10%, 500V CK62BX102K per MIL-C-11015B	Filter Capacitor for V803B. Figure 7-3.
C814		CAPACITOR, FIXED, MICA: 47 uuf, ±5%, 500V CM15C470JN3 per MIL-C-5B	Compensating Capacitor for constant Current Circuit. Figure 7-3.
C815		Same as C806	Compensating Variable Capacitor for Constant Current Circuit. Figure 7-3.
C816		Same as C807	Compensating Capacitor for Constant Current Circuit. Figure 7-3.
C817		Same as C813	Plate Decoupling for V805A and V805B. Figure 7-3.
C818		Same as C813	Decoupling for 110V Supply. Figure 7-3.
C819		CAPACITOR, VARIABLE: 0.7 - 3.0 uuf, 350V (72982 # SK-1459-01-000)	Amplifier Input Capacity Trimmer. Figure 7-3.
C820		CAPACITOR; FIXED, CERAMIC: .02 uf, ±20%, 500V (72982 #841-010W5R203M)	-100V Supply Filter. Figure 7-1.
C821		Same as C820	+110V Supply Filter. Figure 7-1.
C822		Same as C804	-6.3V Supply Filter to V1. Figure 7-3.

TABLE 7-1. MAINTENANCE PARTS LIST (CONTINUED)

REF. DESIG.	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
C823		Same as C802	Decoupling Capacitor for V801A Plate. Figure 7-3.
C1801		CAPACITOR, FIXED, PLASTIC: .1 uf, ±20%, 600V (01934 type 27)	Input Coupling Capacitor. Figure 7-1.
C1802		Not Assigned	
C1803		Same as C819	Input Capacity Trimmer for .1 Position of S802. Figure 7-1.
C1804		CAPACITOR, Fixed, Ceramic 10 uuf, ±.25uuf, 500V, CC20CH100C per MIL-C-20D	Compensating Capacitor for .1 position of S802. Figure 7-4.
C1805		Same as C819	Compensating Trimmer for .1 Position of S802. Figure 7-1.
C1806		CAPACITOR, FIXED, CERAMIC: 2.2 uuf, ±.25 uuf, 500V, CC22CK2R2C per MIL-C-20D	Input Capacity Padder for .2 Position of S802. Figure 7-1.
C1807		Same as C819	Input Capacity Trimmer for .2 Position of S802. Figure 7-1.
C1808		CAPACITOR, FIXED, CERAMIC: 3.3 uuf, ±.25 uuf, 500V, CC22CJ3R3C per MIL-C-20D	Compensating Capacitor for .2 Position of S802. Figure 7-4.
C1809		Same as C819.	Compensating Trimmer for .2 Position of S802. Figure 7-1.
C1810		Same as C1808	Compensating Capacitor for .2 Position of S802. Figure 7-1.
C1811		Same as C1808	Input Capacity Padder for .5 Position of S802. Figure 7-1.
C1812		Same as C819	Input Capacity Trimmer for .5 Position of S802. Figure 7-1.
C1813		Same as C1806	Compensating Capacitor for .5 Position of S802. Figure 7-4.
C1814		Same as C819	Compensating Trimmer for .5 Position of S802. Figure 7-1.

TABLE 7-1. MAINTENANCE PARTS LIST (CONTINUED)

REF. DESIG.	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
C1815		CAPACITOR, FIXED, MICA: 22 uuf, ±5%, 500V, CM15C220JN3 per MIL-C-5B	Compensating Capacitor for .5 Position of S802. Figure 7-1.
C1816		CAPACITOR, FIXED, CERAMIC: 4.7 uuf, ±.25 uuf, 500V, CC22CH4R7C per MIL-C-20D	Input Capacity Padder for 1.0 Position of S802. Figure 7-1.
C1817		Same as C819	Input Capacity Trimmer for 1.0 Position of S802. Figure 7-1.
C1818		Same as C819	Compensating Trimmer for 1.0 Position of S802. Figure 7-1.
C1819		Same as C814	Compensating Capacitor for 1.0 Position of S802. Figure 7-1.
C1820 thru C1823		Not Assigned	
C1824		Same as C1816	Input Capacity Padder for 2.0 Position of S802. Figure 7-2.
C1825		Same as C819	Input Capacity Trimmer for 2.0 Position of S802. Figure 7-2.
C1826		Same as C819	Compensating Trimmer for 2.0 Position of S802. Figure 7-2.
C1827		CAPACITOR, FIXED, MICA: 100 uuf, ±5%, 300V, CB11RD101J per MIL-C-10950B	Compensating Capacitor for 2.0 Position of S802. Figure 7-2.
C1828		Same as C1816	Input Capacity Padder for 5.0 Position of S802. Figure 7-2.
C1829		Same as C819	Input Capacity Trimmer for 5.0 Position of S802. Figure 7-2.
C1830		Same as C819	Compensating Trimmer for 5.0 Position of S802. Figure 7-2.
C1831		CAPACITOR, FIXED, MICA: 220 uuf, ±5%, 300V, CB11RD221J per MIL-C-10950B	Compensating Capacitor for 5.0 Position of S802. Figure 7-2.

TABLE 7-1. MAINTENANCE PARTS LIST (CONTINUED)

REF. DESIG.	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
C1832		Same as C1816	Input Capacity Padder for 10 Position of S802. Figure 7-2.
C1833		Same as C819	Input Capacity Trimmer for 10 Position of S802. Figure 7-2.
C1834		Same as C819	Compensating Trimmer for 10 Position of S802. Figure 7-2.
C1835		CAPACITOR, FIXED, MICA: 470 uuf, ±5%, 300V, CB11RD471J per MIL-C-10950B	Compensating Capacitor for 10 Position of S802. Figure 7-2.
C1836		Same as C1816	Input Capacity Padder for 20 Positive of S802. Figure 7-2.
C1837		Same as C819	Input Capacity Trimmer for 20 Position of S802. Figure 7-2.
C1838		Same as C819	Compensating Trimmer for 20 Position of S802. Figure 7-2.
C1839		CAPACITOR, FIXED, MICA: 1000 uuf, ±5%, 300V, CB11RD102J per MIL-C-10950B	Compensating Capacitor for 20 Position of S802. Figure 7-2.
E801		COVER, CONNECTOR: BNC Type CW-123A/U per MIL-C-3608A	Input Cathode Follower of X10 Input Amplifier. Figures 7-1 and 7-2.
E802		SHIELD, TUBE: S0967 per MIL-S-19786B	X10 Output Cathode Follower and X10 Output Amplifier. Figure 7-1.
J801		CONNECTOR, RECEPTACLE: BNC Panel Type UG-652B/U per MIL-C-3608A	Input Connector. Figure 7-1.
L801		COIL, RF: 0.68 uh, ±20% (700 ma, .15 ohm) MS75008-5 per MIL-C-15305B	Shunt Peaking Coil for V801B. Figure 7-3.
L802		COIL, RF: 0.47 uh, ±20% MS75008-4 per MIL-C-15305B	Series Peaking Coil for V801B. Figure 7-3.
L803		COIL, RF, VARIABLE: 0.55 - 1.1 uh, ±10% (28569 #3320-294)	HF Variable Peaking Coil for V802A. Figure 7-3.

TABLE 7-1. MAINTENANCE PARTS LIST (CONTINUED)

REF. DESIG.	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
L804		Same as L802	Series Peaking Coil for V802A. Figure 7-3.
L805		Same as L803	HF Variable Peaking Coil for V803A. Figure 7-3.
L806		Same as L803.	HF Variable Peaking Coil for V803B. Figure 7-3.
L807		COIL, RF: 5.6uh, ±10% MS75008-13 per MIL-C-15305B	Vernier Compensating Coil. Figure 7-1.
L808		Same as L802	Series Peaking Coil for V803A. Figure 7-3.
L809		Same as L802	Series Peaking Coil for V803B. Figure 7-3.
L810		COIL, RF: 4.7 uh, ±10%, (1200 ma, .6 ohm) MS16221-7 per MIL-C-15305B	Filter Choke for V802 and V803 heater. Figure 7-3.
L811		Same as L810	Filter Choke for V801 Heater. Figure 7-3.
L812		Same as L802	Series Peaking Coil for V802B. Figure 7-1.
P801		CONNECTOR, PLUG: 16 contact (02660 #26-4100-16P)	Preamplifier Power and Signal Connector. Figure 7-1.
R801		RESISTOR, FIXED, COMPOSITION: 100K, ±10%, 1/4 watt RC07GF104K per MIL-R-11D	Input Current Limiting Resistor. Figure 7-4.
R802		Same as R801	X10 Input Current Limiting Resistor. Figure 7-3.
R803		RESISTOR, FIXED, COMPOSITION: 1 megohm, ±10%, 1/2 watt RC20GF105K per MIL-R-11D	Grid Resistor for V801B. Figure 7-3.
R804		RESISTOR, FIXED, FILM: 680 ohms, ±5%, 1/2 watt RL20AD681J per MIL-R-22684	Plate Load Resistor for V801B. Figure 7-3.
R805		RESISTOR, FIXED, FILM: 120 ohms, ±5%, 1/2 watt RL20AD121J per MIL-R-22684	Cathode Resistor for V801B. Figure 7-3.

TABLE 7-1. MAINTENANCE PARTS LIST (CONTINUED)

REF. DESIG.	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
R806		RESISTOR, FIXED, COMPOSITION: 47 ohms, ±10%, 1/4 watt RC07GF470K per MIL-R-11D	Damping Resistor for V801A Grid. Figure 7-3.
R807		RESISTOR, FIXED, FILM: 6800 ohms, ±5%, 2 watt RL42AD682J per MIL-R-22684	Cathode Resistor for V801A. Figure 7-1.
R808		RESISTOR, FIXED, COMPOSITION: 1000 ohms, ±10%, 1/2 watt RC20GF102K per MIL-R-11D	Decoupling Resistor for V801A Cathode. Figure 7-1.
R809		Same as R807	Cathode Resistor for V802B. Figure 7-1.
R810		RESISTOR, FIXED, COMPOSITION: 2200 ohms, ±10%, 2 watt RC42GF222K per MIL-R-11D	Decoupling Resistor for V801B. Figure 7-1.
R811		RESISTOR, FIXED, FILM: 820 ohms, ±5%, 1/4 watt RL07AD821J per MIL-R-22684	Damping Resistor for L802. Figure 7-3.
R812		Same as R811	Damping Resistor for L804. Figure 7-1.
R813		Same as R810	Decoupling Resistor for V802A. Figure 7-1.
F814		Same as R803	Grid Resistor for V802A. Figure 7-3.
R815		RESISTOR, FIXED, COMPOSITION: 100 ohms, ±10%, 1/2 watt RC20GF101K per MIL-R-11D	Cathode Resistor for V802A. Figure 7-3.
R816		Same as R804	Plate Load Resistor for V802A. Figure 7-3.
R817		RESISTOR, VARIABLE: 5000 ohms, ±10%, 2 watt RV4NAYSD502A per MIL-R-94B	X10 Balance Potentiometer. Figure 7-2.
R818		RESISTOR, FIXED, COMPOSITION: 47K, ±10%, 1/2 watt RC20GF473K per MIL-R-11D	Balance Potentiometer Voltage Divider. Figure 7-3.
R819		Same as R817	Balance Potentiometer. Figure 7-1.
R820		RESISTOR, VARIABLE: 2500 ohms, ±10%, 2 watt RV4NAYSD252A per MIL-R-94B	Amplifier Gain Adjustment Resistor. Figure 7-1.
R821		Same as R820	X10 Amplifier Gain Adjustment Resistor. Figure 7-2.
R822		RESISTOR, FIXED, COMPOSITION: 2200 ohms, ±10%, 2 watt RC42GF222K per MIL-R-11D	Decoupling Resistor for V801 Plate. Figure 7-3.

TABLE 7-1. MAINTENANCE PARTS LIST (CONTINUED)

REF. DESIG.	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
R823		Same as R803	Grid Resistor for V802B. Figure 7-3.
R824		Same as R806.	Damping Resistor for V803A Grid. Figure 7-3.
R825		Same as R807	Cathode Resistor for V803A Grid. Figure 7-3.
R826		Same as R807	Cathode Resistor for V803B. Figure 7-3.
R827		Not Assigned	
R828		Same as R806	Damping Resistor for V803B Grid. Figure 7-3.
R829		RESISTOR, FIXED, FILM: 542 ohms, ±0.5%, 1/2 watt RN70C5420D per MIL-R-10509D	Plate Load Resistor for V803A. Figure 7-3.
R830		RESISTOR, VARIABLE: 1000 ohms, ±10%, 1 watt w/spst switch (71450 type RGC90)	Vernier Gain Adjustment. Figure 7-1.
R831		Same as R829	Plate Load Resistor for V803B. Figure 7-3.
R832		Same as R811	Damping Resistor for L808 Coil. Figure 7-3.
R833		Same as R808	Vernier Shunt Resistor. Figure 7-1.
R834		Same as R811	Damping Resistor for L809 Coil. Figure 7-3.
R835		RESISTOR, FIXED, FILM: 200K, ±1%, 1/2 watt RN70B2003F per MIL-R-10509D	Voltage Dropping Resistor. Figure 7-3.
R836		Same as R835	Voltage Dropping Resistor. Figure 7-3.
R837		Same as R803	Capacity Isolation Resistor. Figure 7-3.
R838		RESISTOR, FIXED, FILM: 82.5K, ±1%, 1/2 watt RN70B8252F per MIL-R-10509D	Cathode Resistor for V804B. Figure 7-3.
R839		Same as R838	Cathode Resistor for V804A. Figure 7-3.

TABLE 7-1. MAINTENANCE PARTS LIST (CONTINUED)

REF. DESIG.	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
R840		Same as R803	Capacity Isolation Resistor. Figure 7-3.
R841 thru R849		Not Assigned	
R850		Same as R817	Vertical Positioning Potentiometer. Figure 7-2.
R851		Same as R806	Damping Resistor for V805B Grid. Figure 7-3.
R852		RESISTOR, FIXED, FILM: 37.4K, ±1%, 1/2 watt RN70B3742F per MIL-R-10509D	Voltage Divider for V804 Grids. Figure 7-3.
R853		RESISTOR, FIXED, FILM: 46.4K, ±1%, 1/2 watt RN70B4642F per MIL-R-10509D	Voltage Divider for V804 Grids. Figure 7-3.
R854		Same as R806	Damping Resistor for V805A Grid. Figure 7-3.
R855		Same as R807	Cathode Resistor for V805B. Figure 7-3.
R856		Same as R807	Cathode Resistor for V805A. Figure 7-3.
R857		RESISTOR, FIXED, COMPOSITION: 1000 ohms, ±10%, 2 watt RC42GF102K per MIL-R-11D	Plate Decoupling Resistor for V805A and V805B. Figure 7-3.
R858		RESISTOR, FIXED, COMPOSITION: 1500 ohms, ±10%, 1/2 watt RC20GF152K per MIL-R-11D	Termination Resistor for Blanking Delay Line. Figure 7-1.
R859		RESISTOR, FIXED, COMPOSITION: 220 ohms, ±10%, 1/2 watt RC20GF221K per MIL-R-11D	Decoupling Resistor for V802B Plate. Figure 7-3.
R860		RESISTOR, FIXED, COMPOSITION: 10 ohms, ±10%, 1/2 watt RC20GF100K per MIL-R-11D	Decoupling Resistor for +110V Supply. Figure 7-3.
R861		RESISTOR, FIXED, COMPOSITION: 15 ohms, ±10%, 1/4 watt RC07GF150K per MIL-R-11D	Input Damping Resistor. Figure 7-1.
R862		RESISTOR, FIXED, COMPOSITION: 680 ohms, ±10%, 1/2 Watt RC20GF681K per MIL-R-11D	Damping Resistor for L812. Figure 7-1.

TABLE 7-1. MAINTENANCE PARTS LIST (CONTINUED)

REF. DESIG.	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
R1801		RESISTOR, FIXED, FILM: 1 megohm, ±1%, 1/2 watt RN70B1004F per MIL-R-10509D	Grid Resistor for V801A. Figure 7-4.
R1802		RESISTOR. FIXED, COMPOSITION: 15 ohms, ±10%, 1/2 watt RC20GF150K per MIL-R-11D	Attenuator Damping Resistor. Figure 7-4.
R1803		RESISTOR, FIXED, FILM: 499K, ±1%, 1/2 watt RN70B4993F per MIL-R-10509D	Input-Half Voltage Divider for .1 Position of S802. Figure 7-4.
R1804		Same as R860	Attenuator Compensator Resistor for .1 Position of S802. Figure 7-4.
R1805		Same as R1801	Output-Half Voltage Divider for .1 Position of S802. Figure 7-1.
R1806		RESISTOR, FIXED, FILM: 750K, ±1%, 1/2 watt RN70B7503F per MIL-R-10509D	Input-Half Voltage Divider for .2 Position of S802. Figure 7-4.
R1807		Same as R860	Attenuator Compensator Resistor for .2 Position of S802. Figure 7-4.
R1808		RESISTOR, FIXED, FILM: 332K, ±1%, 1/2 watt RN70B3323F per MIL-R-10509D	Output-Half Voltage Divider for .2 Position of S802. Figure 7-1.
R1809		RESISTOR, FIXED, FILM: 909K, ±1%, 1/2 watt RN70B9093F per MIL-R-10509D	Input-Half Voltage Divider for .5 Position of S802. Figure 7-4.
R1810		Same as R860	Attenuator Compensator Resistor for .5 Position of S802. Figure 7-4.
R1811		RESISTOR, FIXED, FILM: 111K, ±0.5%, 1/2 watt RN70C1113D per MIL-R-10509D	Output-Half Voltage Divider for .5 Position of S802. Figure 7-1.
R1812		RESISTOR, FIXED, FILM: 953K, ±1%, 1/2 watt RN70B9533F per MIL-R-10509D	Input-Half Voltage Divider for 1.0 Position of S802. Figure 7-4.

TABLE 7-1. MAINTENANCE PARTS LIST (CONTINUED)

REF. DESIG.	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
R1813		Same as R860	Attenuator Compensator Resistor for 1.0 Position of S802. Figure 7-4.
R1814		RESISTOR, FIXED, FILM: 52.3K, ±1%, 1/2 watt RN70B5232F per MIL-R-10509A	Output-Half Voltage Divider for 1.0 Position of S802. Figure 7-1.
R1815		RESISTOR, FIXED, FILM: 976K, ±1%, 1/2 watt RN70B9763F per MIL-R-10509D	Input-Half Voltage Divider for 2.0 Position of S802. Figure 7-4.
R1816		Same as R860	Attenuator Compensator Resistor for 2.0 Position of S802. Figure 7-4.
R1817		RESISTOR, FIXED, FILM: 25.5K, ±1%, 1/4 watt RN65B2552F per MIL-R-10509D	Output-Half Voltage Divider for 2.0 Position of S802. Figure 7-4.
R1818		RESISTOR, FIXED, FILM: 988K, ±0.5%, 1/2 watt RN70C9883D per MIL-R-10509D	Input-Half Voltage Divider for 5.0 Position of S802. Figure 7-4.
R1819		Same as R860	Attenuator Compensator Resistor for 5.0 Position of S802. Figure 7-4.
R1820		RESISTOR, FIXED, FILM: 10.1K, ±0.5%, 1/4 Watt RN65C1012D per MIL-R-10509D	Output-Half Voltage Divider for 5.0 Position of S802. Figure 7-4.
R1821		Same as R1801	Input-Half Voltage Divider for 10 Position of S802. Figure 7-4.
R1822		Same as R860	Attenuator Compensator Resistor for 10 Position of S802. Figure 7-4.
R1823		RESISTOR, FIXED, FILM: 5050 ohms, ±0.5%, 1/4 watt RN65C5051D per MIL-R-10509D	Output-Half Voltage Divider for 10 Position of S802. Figure 7-4.

TABLE 7-1. MAINTENANCE PARTS LIST (CONTINUED)

REF. DESIG.	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
R1824		Same as R1801	Input-Half Voltage Divider for 20 Position of S802. Figure 7-4.
R1825		Same as R860	Attenuator Compensator Resistor for 20 Position of S802. Figure 7-4.
R1826		RESISTOR, FIXED, FILM: 2520 ohms, ±0.5%, 1/4 watt RN65B2521F per MIL-R-10509D	Output-Half Voltage Divider for 20 Position of S802. Figure 7-4.
S801		SWITCH, ROTARY: (28569 #19912-538)	DC-AC-ACX10 Switch. Figure 7-1.
S802		SWITCH, ROTARY: (28569 #19912-539)	Attenuator Switch. Figures 7-1 & 7-4.
V801		ELECTRON TUBE: USN6922, MIL-E-1/1168	Input Cathode Follower and X10 Input Amplifier. Figure 7-3.
V802		Same as V801	X10 Output Amplifier and Cathode Follower. Figure 7-3.
V803		Same as V801	Main Amplifier and Phase Inverter. Figure 7-3.
V804		ELECTRON TUBE: 12AT7WA, MIL-E-1/3	Constant Current Generator. Figure 7-3.
V805		Same as V801	Output Cathode Followers. Figure 7-3.
XC809		SOCKET, TUBE: (For electrolytic capacitor) TS101P02 per MIL-S-12883A	
XV801		SOCKET, TUBE: 9 contact, Noval, UHF, printed circuit type (91662 #3901PHSPTD)	
XV802		Same as XV801	
XV803		Same as XV801	
XV804		SOCKET, TUBE: 9 contact, Noval, with integral tube shield base, printed circuit board type. (71785 #44P24233)	
XV805		Same as XV801	

TABLE 7-1. MAINTENANCE PARTS LIST (CONTINUED)

REF. DESIG.	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
MP801		LATCH: (94222 #48-10-101-10)	
MP802		KNOB: (28569 #11505-87)	DC-AC-ACX10 Switch Knob.
MP803		KNOB: (28569 #11505-90)	Sensitivity (Volts/CM) Knob.
MP804		KNOB: (28569 #11505-91)	Vertical Position Control Knob.
MP805		KNOB: (28569 #11505-94)	Vernier Control Knob.

TABLE 7-2. LIST OF MANUFACTURERS

CODE NO.	MANUFACTURER
00853	Sangamo Electric Co., 1207 N. Eleventh St., Springfield, Ill.
09134	Texas Capacitor Co., Houston, Texas
01121	Allen Bradley Co., 118 W. Greenfield Ave., Milwaukee 4, Wisc.
01295	Texas Instruments Inc., 13500 N. Central Expwy., Box 5474, Dallas, Texas
02114	Ferroxcube Corp. of America, 125 E. Bridge St., Saugerties, N.Y.
02642	Tech-Ohm Electronics, Inc., 36-11 33rd St., Long Island City, N.Y.
02660	Amphenol-Borg Electronics, 1830 South 54th Ave., Chicago 50, Ill.
12697	Clarostat Mfg. Co. Inc., Washington Street, Brooklyn, N.Y.
14674	Corning Glass Works, Electrical Products Div., Corning, N.Y.
19701	Electra Mfg. Co., 4051 Broadway, Kansas City, Mo.
28480	Hewlett-Packard Co., 1058 Page Mill Road, Palo Alto, Calif.
28569	Hickok Electrical Instrument Co., 10514 Dupont Ave., Cleveland 8, Ohio
56289	Sprague Electric Co., 481 Marshall St., North Adams, Mass.
58474	Superior Electric Co., 83 Laurel St., Bristol, Conn.
71400	Bussman Mfg. Co., University at Jefferson St., St. Louis, Mo.
71450	Chicago Telephone Supply, Elkhart, Ind.
71590	Centralab Div. of Globe Union Inc., 900AE Keefe Ave., Milwaukee, Wisc.
71785	Cinch Mfg. Corp., 1026 So. Homan Ave., Chicago 24, Ill.
72982	Erie Resistor Corp., 644 West 12th St., Erie, Pa.
73138	Helipot Corp., 2500 Harbor Blvd., South Pasadena, Calif.
76433	Micamold Electronics Mfg. Corp., 65 Governeur St., Newark, N.J.
76854	Oak Mfg. Co., 1260 Clybourn Ave., Chicago, Ill.
77764	Resistance Products Co., 914 South 13th St., Harrisburg, Pa.
80211	Motorola Semiconductor Products Inc., 5005 E. McDowell Rd., Phoenix, Ariz.
81716	Oak Mfg. Co., Crystal Lake, Ill.
82647	Klixon Co., Div. of Spencer Thermostat Corp., Attleboro, Mass.
91662	Elco Corp., "M" St. below Erie Ave., Philadelphia, Pa.
93519	General Electric Supply Corp., Lamp Works (Nela Park), Cleveland, Ohio
94222	Southco Division of South Chester Corp., Lester, Pa.
95265	National Coil Co., Box 1237, Sheridan, Wyo.
96312	Dialight, 60 Stewart Ave., Brooklyn, N.Y.
97315	Ballastran, Div. Telex, 1701 N. Calhoun St., Ft. Wayne, Ind.
99800	Delavan Electronics Corp., 77 Olean Road, East Aurora, N.Y.
98734	Palo Alto Engineering Co. Inc., Palo Alto, Calif.

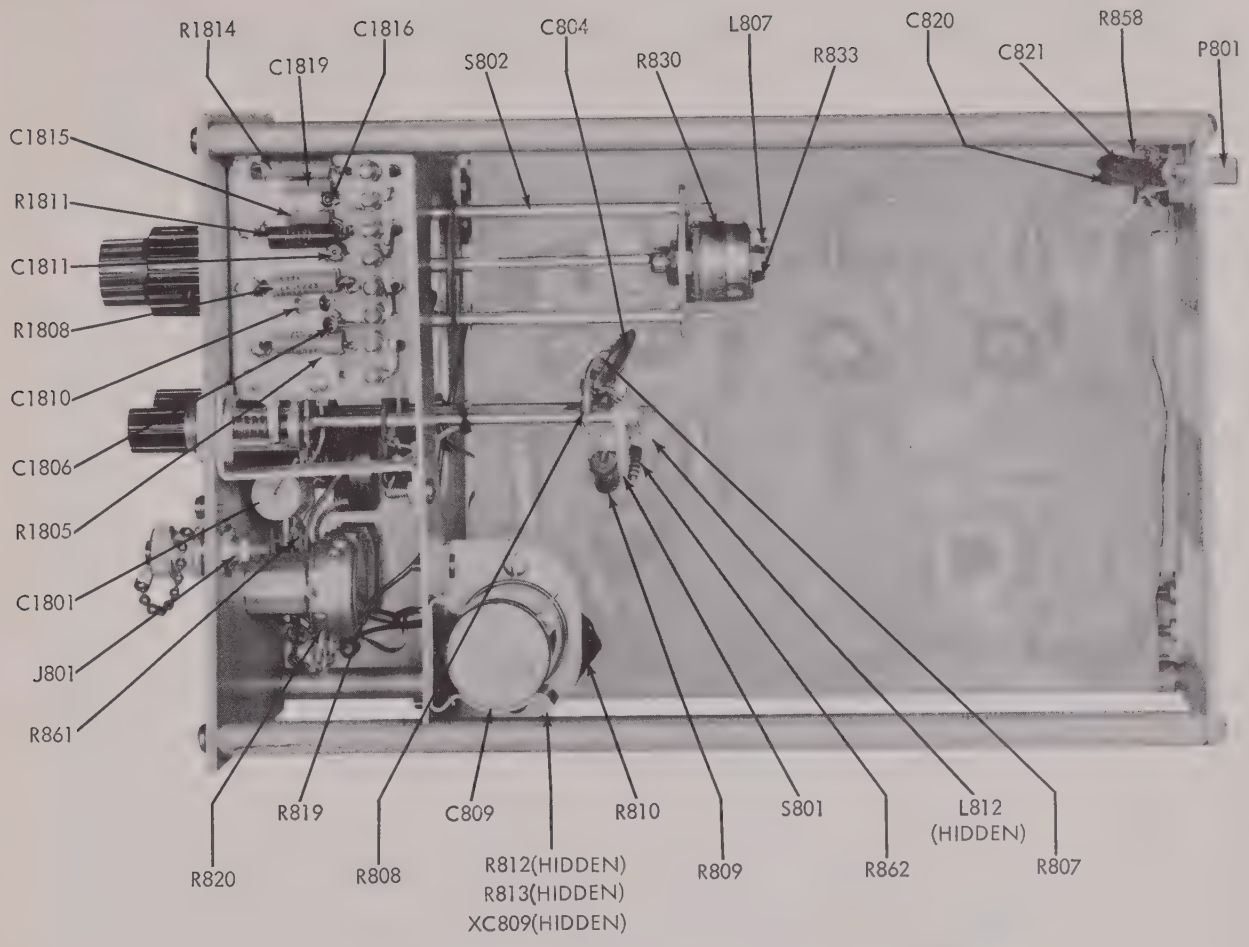

FIGURE 7-1. LOCATION OF PARTS, RIGHT SIDE

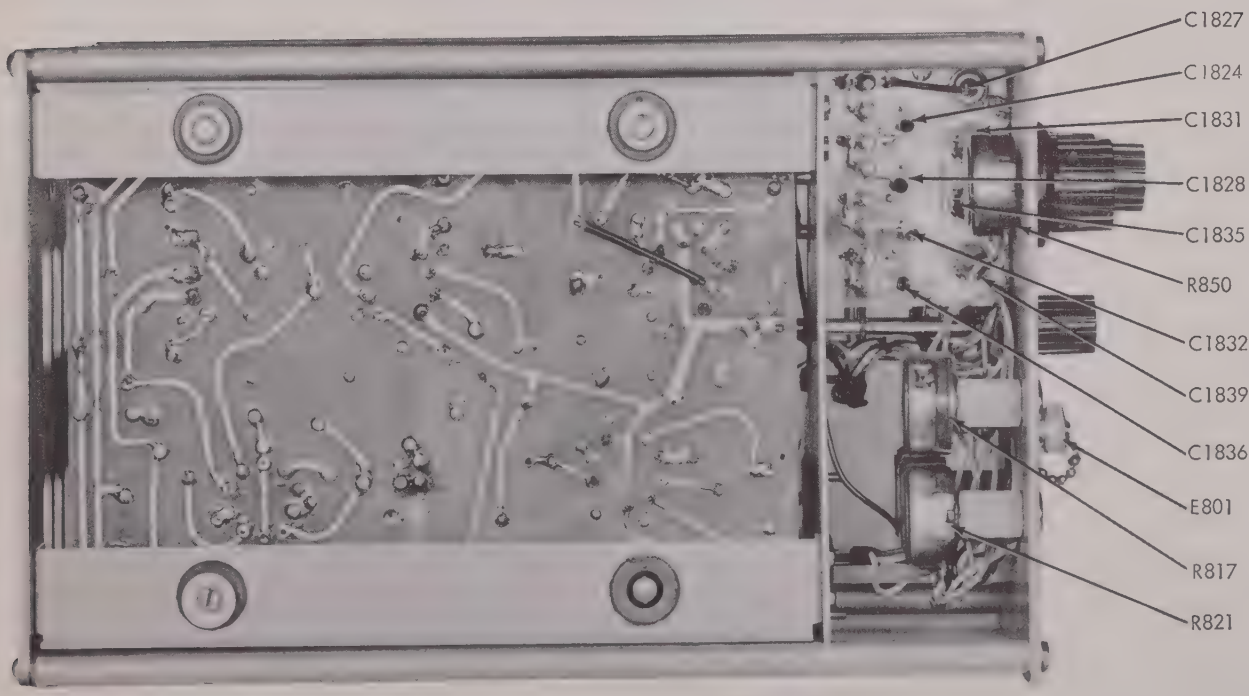

FIGURE 7-2. LOCATION OF PARTS, LEFT SIDE

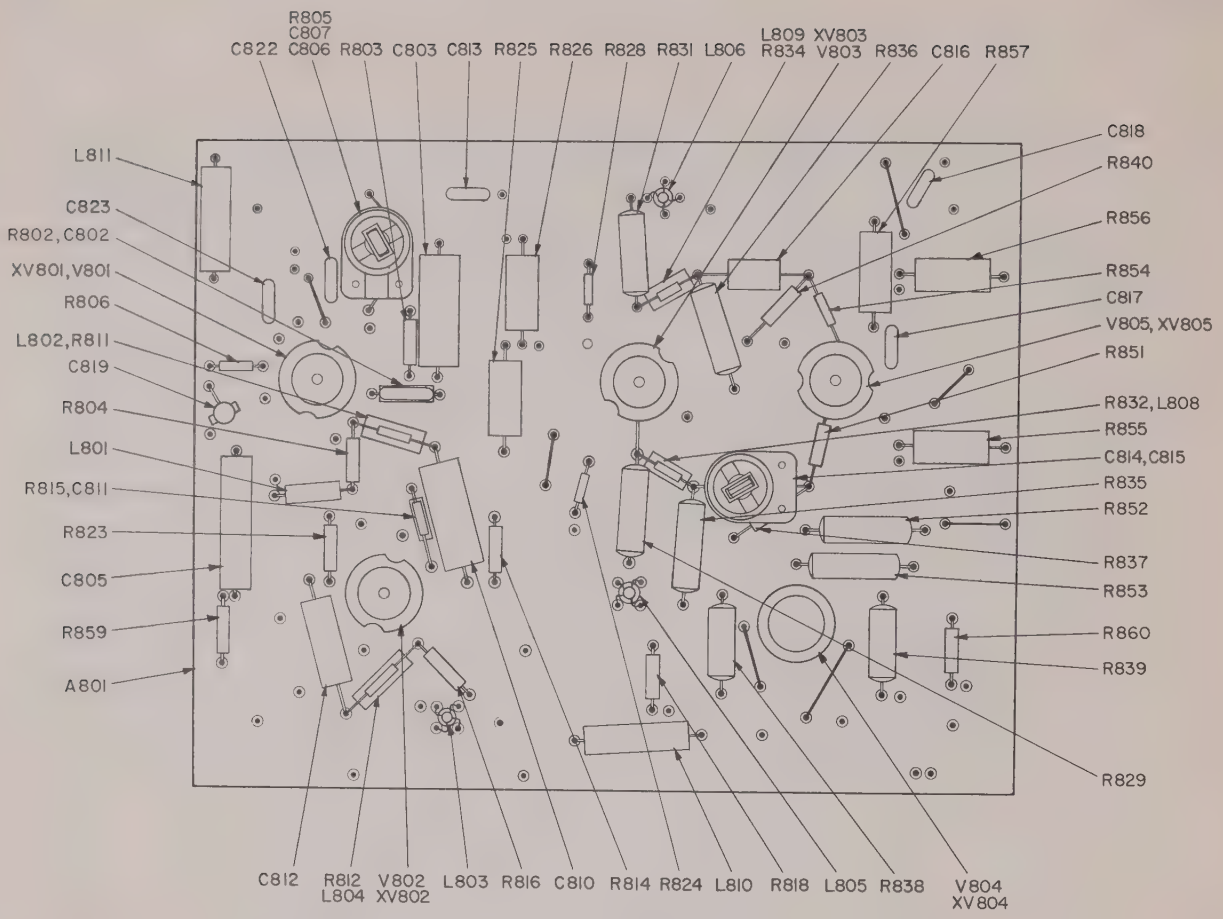

FIGURE 7-3. LOCATION OF PARTS, CIRCUIT BOARD A801

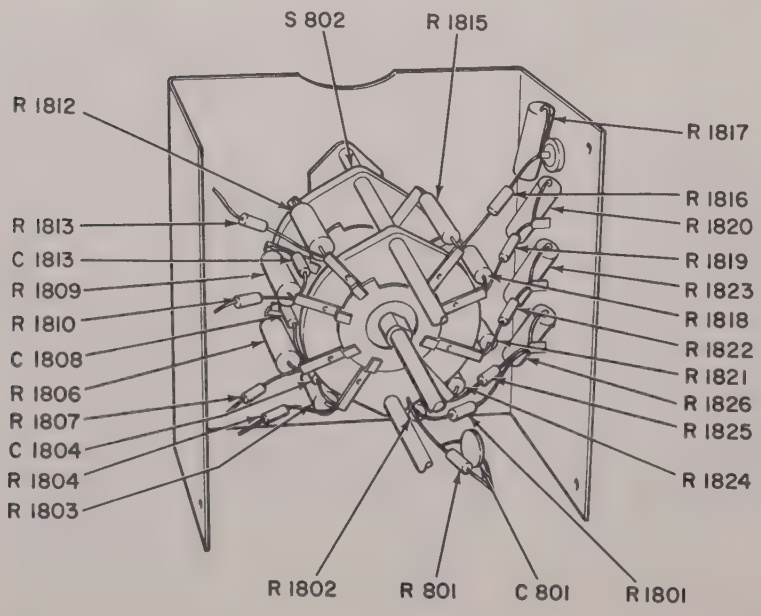

FIGURE 7-4. LOCATION OF PARTS, ATTENUATOR SWITCH

NOTES

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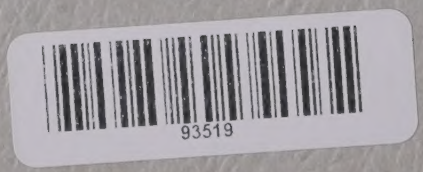

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